The PROGRESSIVE FISH-CULTURIST

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UNITED STATES DEPARTMENT OF THE INTERIOR
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PROGRESSIVE FISH-CULTURIST

ISSUED BY

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FISH AND WILDLIFE SERVICE - - - - - - - - - - - - - - - - - IRA N. GABRIELSON, DIRECTOR

A SERIAL memorandum published occasionally for the advancement of fish-culture and fishery management in fresh waters.

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The PROGRESSIVE FISH-CULTURIST
News and Views from many Sources on Practical Hatchery Problems

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BUILDING NEW SALMON RUNS

PUGET SOUND SOCKEYE SALMON PLANTINGS SHOW VARYING DEGREES OF SUCCESS

By Loyd A. Royal and Allyn Seymour
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ATTEMPTS TO establish sockeye salmon, Oncorhynchus nerka, in streams of the Puget Sound area previously barren of the species yielded most interesting returns in the fall of 1940. These returns, which resulted from plantings of hatchery-raised fry and fingerlings, ranged from complete failure of any adult sockeye salmon to return to May Creek to a surprisingly large return of an estimated 9,099 mature individuals to Issaquah Creek.

All of the streams had been stocked with sockeye salmon raised from eggs taken at the hatchery of the former United States Bureau of Fisheries at Birdsview. In the fall of 1936 this hatchery received an exceptionally large return of sockeye salmon in Grandy Creek. The Grandy Creek run originated from eggs transplanted from Baker Lake sockeye salmon, both Grandy Creek and Baker Lake being tributaries to the Skagit River. Because the flow of water in Grandy Creek diminished progressively during the fall months, the former Bureau of Fisheries decided to ship a considerable quantity of the eggs away from the Birdsview station and offered the Washington State Department of Fisheries a total of about 4,000,000. Of this number 1,250,000 eyed eggs were shipped from Birdsview in December 1936 to be reared in 3 of the State's hatcheries. The remainder of the eggs were retained at Birdsview and later transferred as fry to streams in the Puget Sound area specified by the Washington State Department of Fisheries.

Some care had to be exercised in selecting a locality for planting this species owing to the natural tendency of mature sockeye salmon to seek spawning areas in a stream tributary to a lake. For this reason the fry were planted only in a water system in which a lake could be found somewhere along its course. Five localities were chosen.

One of the streams selected was May Creek, the outlet of Lake Isabel and tributary to the Snohomish River system, which lies about 30 miles north of Seattle. May Creek is similar to Grandy Creek in that both are small streams, outlets from a lake and tributary to a large river. A shipment of 250,000 eyed eggs was sent from Birdsview to the Skykomish Hatchery on May Creek December 22, 1936. On April 5, 1937, 246,402 fry were released from the hatchery in May Creek near its mouth and several miles below Lake Isabel. No adult sockeye salmon returned from this planting and the lack of return may be explained in part or in whole by the fact that the planting was made below the lake.

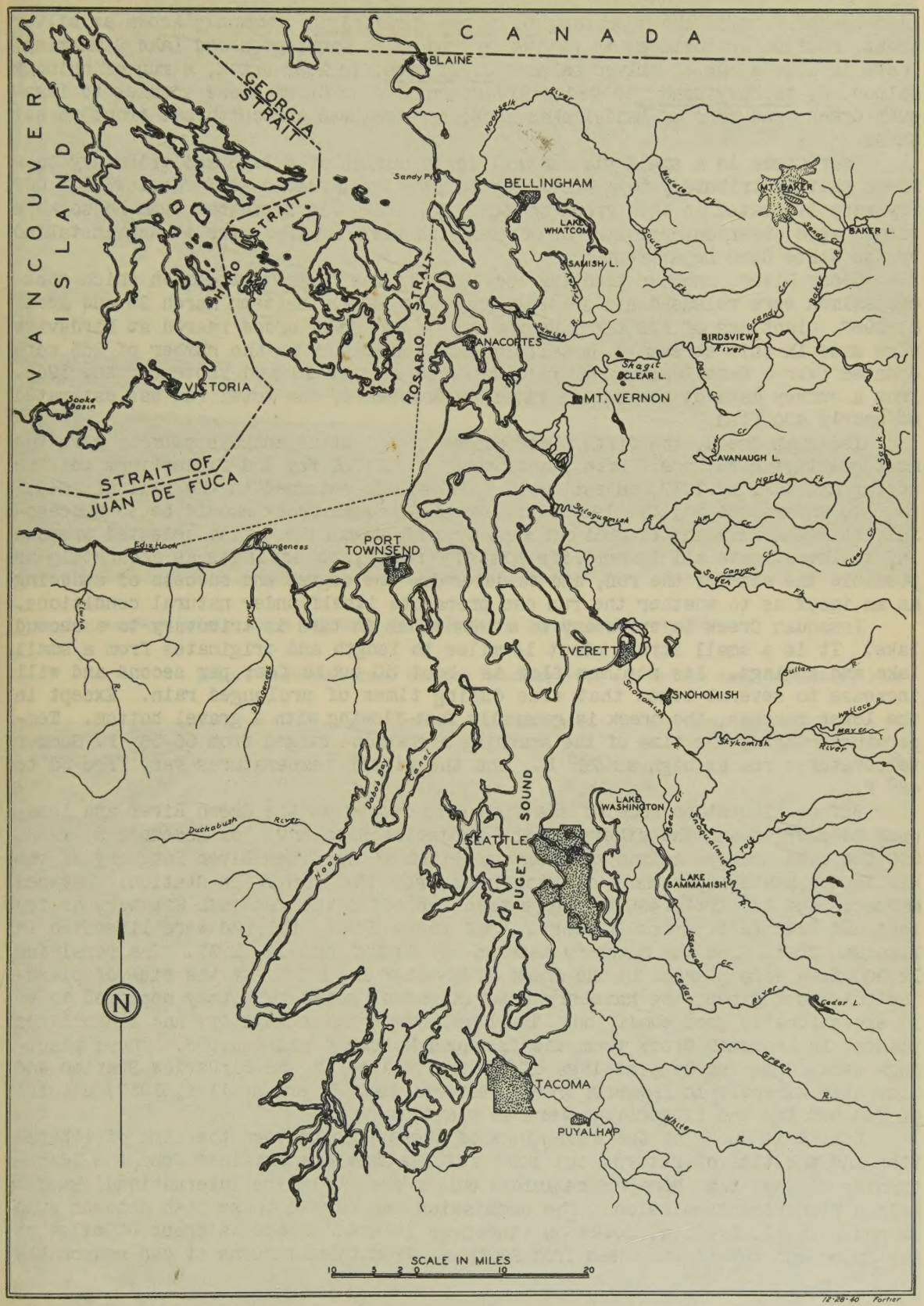
Another planting location was Samish Lake, a lake about 4 miles long and less than a mile wide. It has no tributaries of any consequence and drains into Puget Sound 75 miles north of Seattle. From the outlet of the lake to Puget Sound is a distance of 20 miles following Friday Creek and the Samish River. Five hundred thousand eyed eggs from Birdsview were delivered to Samish Hatchery December 2, 1936. Between March 17 and June 28, 1937, 487,170 sockeye fry from this lot were planted in Samish Lake. The returning mature sockeye in the fall of 1940 were estimated at between 300 and 400.

The three other places where sockeye fry were planted - Bear Creek, Cedar River and Issaquah Creek- are all within a few miles of each other. Ten miles

The Issaquah salmon hatchery of the Washington State Department of Fisheries.

to the east of the City of Seattle lies Lake Sammamish. It is 8 miles long and 1 mile wide and its only important tributary is Issaquah Creek, which enters the lake at its southern end. The outlet of the lake is the Sammamish River, a sluggish meandering stream, which flows from the northern end of the lake in a westerly direction for 12 miles into the northern end of Lake Washington. Tributary to the Sammamish River are two small streams,the largest being Bear Creek, the outlet from Cottage Lake. Lake Washington is 20 miles long and 2 miles wide and has two rivers and several smaller streams as tributaries. The rivers are the Sammamish and the Cedar. The Cedar is the larger of the two and flows into Lake Washington at its southern end. The outlet is the Lake Washington ship canal which leaves the lake midway along its western shore. The canal is 6 miles long and passes in a westerly direction through the City of Seattle and Lake Union and enters Puget Sound at the Government locks.

Plantings of sockeye salmon, Oncorhynchus nerka, in these last three places (Bear Creek, Cedar River and Issaquah Creek) were of unusual interest because the



Puget Sound area of the State of Washington. The dotted line indicates the boundary between the "outside" and "inside" fishing areas.

land-locked form of the species, O. nerka kennerlyi, commonly known as silver trout, redfish or kokanee, is native to both Lake Washington and Lake Sammamish. There is also a run of silver salmon, O. kisutch, to Bear Creek; a run of chinook salmon, O. tschawytscha, to Cedar River; runs of both of these species to Issaquah Creek; and runs of land-locked sockeye, steelhead and cutthroat trout to all three.

Bear Creek is a small stream that is an outlet of a lake and tributary to a river that is tributary to a lake. Of the 1936 brood reared at Birdsview, 576,000 fry were liberated in this creek on March 25, 1937. In September 1940 no sockeye salmon were observed here but in October two were counted over a rack installed by the State Game Department.

Cedar River, another planting location, is the largest stream in which sockeye salmon were released and is tributary to a lake. Between March 25 and April 8, 1937, plantings of 656,000 sockeye fry of the 1936 brood reared at Birdsview were made in this stream. Returning adult sockeye to the number of 263 were counted over a Game Department rack between August 18 and September 20, 1940. From a survey made of the entire river on October 4, the total run was estimated at nearly 400 fish.

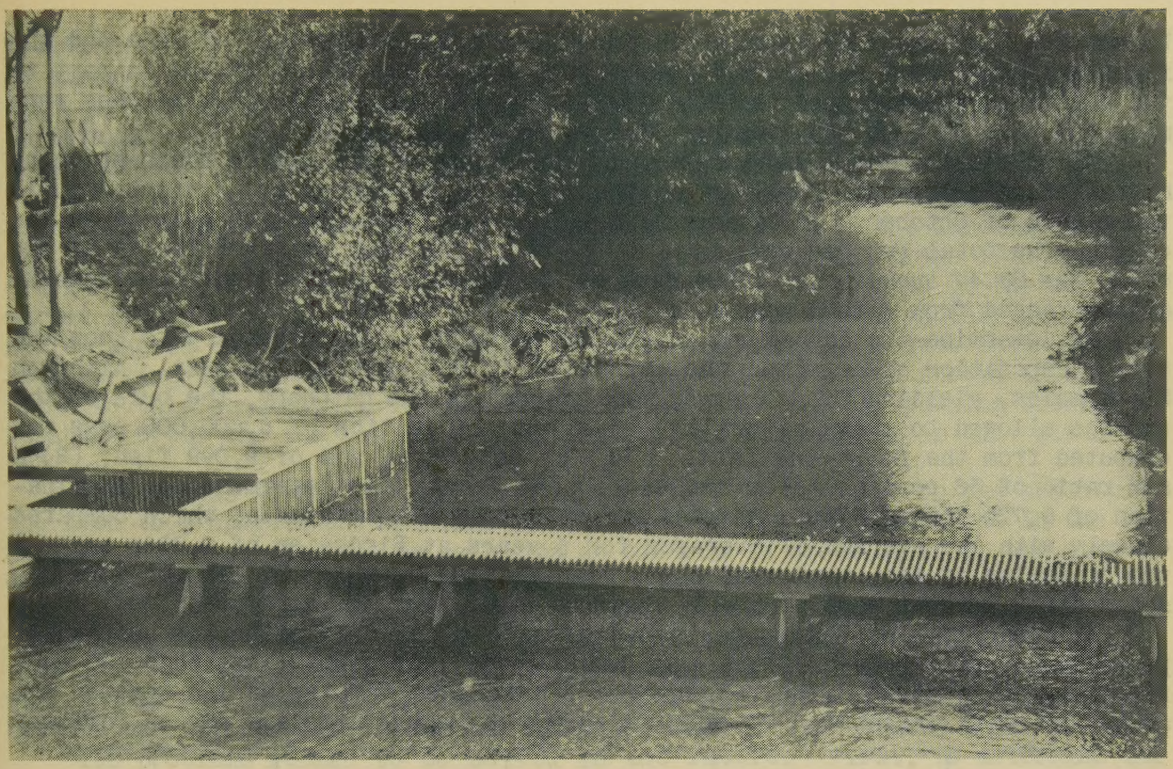
Issaquah Creek, the fifth place chosen for planting sockeye salmon, gave the most gratifying returns. From plantings of 1,257,000 fry and fingerlings in the spring and fall of 1937, an estimated 9,099 adults returned in the fall of 1940.

To understand why the 1937 planting in Issaquah Creek should be so successful, it seems relevant to find out what type of stream these fish selected to spawn in, to investigate all known life history facts, to estimate as accurately as possible the size of the run, and to determine the degree and success of spawning as an index as to whether the run can propagate itself under natural conditions.

Issaquah Creek is tributary to a lake which in turn is tributary to a second lake. It is a small stream about 14 miles in length and originates from a small lake and springs. Its minimum flow is about 30 cubic feet per second and will increase to several times that size during times of prolonged rain. Except in the lower reaches, the creek is generally fast-flowing with a gravel bottom. Temperatures during the time of the spawning migration ranged from 50-58° F. Summer temperatures run as high as 76° F., and the winter temperatures vary from 35 to 48° F.

Before liberation some of the fish were reared in the Green River and Issaquah hatcheries and the others in the Birdsview Hatchery. On December 5, 1936, 500,000 eyed sockeye salmon eggs were received at the Green River Hatchery of the Washington State Department of Fisheries from the Birdsview Station. Between March 13 and 16, 1937, 490,000 were transferred to the Issaquah Hatchery as fry that had been feeding for 3 weeks. Of these fish, 456,176 were liberated in Issaquah Creek from the hatchery between May 20 and June 12, 1937. The remaining 12,900 fish were planted in the creek on November 13, 1937. At the time of planting this last group, the hatchery superintendent noted that they appeared to be in exceptionally good condition. The total number of sockeye fry and fingerlings planted in Issaquah Creek from the Issaquah Hatchery was 469,076. These plantings were augmented by plantings of sockeye reared at the Birdsview Station and liberated directly in Issaquah Creek. Between March 31 and April 6, 1937, a total of 768,000 fry and fingerlings were so planted.

Little is known of the wanderings of these fish between the time of liberation and the time of return, but some information was obtained from the 16 returning sockeye that bore the celluloid bull's-eye tag of the International Pacific Salmon Fisheries Commission. The Commission had tagged these fish between June 13 and July 11, 1940, at Sooke on Vancouver Island. Sooke is about 90 miles up the Sound and toward the ocean from Seattle. From these returns it can reasonably



Spawning sockeye salmon above hatchery rack, Issaquah Creek, September, 1940.

Mature sockeye salmon between hatchery rack and intake dam, September, 1940

be assumed that the bulk of this run passed Sooke during the last of June and the first of July. This being the case, the large return may be attributed in part to the fact that they escaped the "outside" fishery before the largest catches were made and were through the "inside" fishery before it opened.

After passing Sooke, the return of the planted sockeye on their spawning migration into Issaquah Creek began the first of September and continued until the middle of October. On October 26 there were no remaining live sockeye in the creek. The total run was estimated at 9,099.[1] The mean standard length of 204 males was 23.47 inches and of 324 females, 21.68 inches. In weight the fish examined ranged from 4 to 6 pounds.

To determine the degree and success of spawning, it is necessary to know the stream deposition of eggs and the condition of the eggs in the nest. Although 284 females, yielding 837,000 eggs, were spawned at the hatchery, the bulk of the run was allowed to spawn naturally. A stream deposition of 6,600,000 eggs was computed from the following facts: (1) an estimated run of 9,099 fish; (2) a sex ratio of 36 percent males and 64 percent females as determined by examination of 5,775 fish; (3) an estimated egg count of 2,900 per female, which compares closely with the average of averages for 6 years at Birdsview of 2,896; and (4) the condition of the ovaries of 3,634 dead females in which 57 percent were unspawned, 12 percent were partially spawned, and 31 percent were spent.

All dead females that were inspected were classified either as unspawned, partially spawned (one-half the eggs being spent), or spent (less than 250 eggs remaining in ovaries). The percentage of unspawned females varied between the areas and on different days of examination but the season's totals are as follows:

Area No.	Number of dead females	Percentage unspawned	Percentage partly spent	Percentage spent
1	708	60	10	30
2	2,507	58	14	28
3	419	37	16	47
Total	3,634	57	12	31

This unusual number of unspawned fish dying in the creek apparently was the result of fungus growth on the head and especially on the snout and eyes. This fungus was not characteristic of this species alone since the early run of silver salmon was found in the same condition. The fungus was not observed on the later runs of silver salmon occurring after the sockeye run.

The condition of the eggs in the nests was determined by digging up 2 nests. On November 16, 170 eggs were recovered from a nest just below the intake dam pond. Of these eggs 168 were eyed out and 2 were blanks. On the same day 3 miles upstream from the intake dam, 1,331 eggs were recovered from a nest. Of these 1,264 were eyed out and 67 were blanks. This count was not intended to estimate the number of deposited eggs that were fertilized but merely to establish the fact that at least some of the eggs successfully completed the early embryonic stages.

These facts have been presented as a clear cut example of the ability of artificially propagated sockeye to establish themselves, at least for one cycle, in a watershed heretofore uninhabited by the species. Because of geographical

[1] All data on the 1940 spawning migration of sockeye in Issaquah Creek are from a report of D. W. Erickson of the State of Washington Department of Fisheries.

location, the probability that the run to Issaquah Creek might consist of a group of strays is very remote since between salt water and the mouth of Issaquah Creek there are locks, a ship canal, 3 lakes and a river. It is important to note as additional evidence that sockeye salmon, other than an occasional individual, have never before been reported from the lower Puget Sound area. The nearest natural run is to the Skagit River about 55 miles north of Seattle. Whether or not the plantings in the two streams, Bear Creek and Cedar River, in the immediate vicinity of Issaquah Creek could have been the plantings from which the 1940 Issaquah Creek run resulted in whole or in part is not known. Since none of the fry were marked it would be impossible to settle this point one way or another unless the scales showed characteristic markings. Scale examinations to date have shown no such markings. Therefore, since evidence exists that the parent stream theory applies to this species, it is assumed that the 1940 run of spawning sockeye to Issaquah Creek was the result of planting fry and fingerlings in that stream in 1937.

The success of any transplanting experiment is measured by the ability of the fish to propagate and maintain themselves under natural conditions in the new habitat. This success can be estimated at the time of spawning,or at the time of downstream migration, but is not definitely known until the spawning migrants return to the parent stream. To determine the success of the 1940 Issaquah Creek run and to compare the efficiency of artificial propagation with natural propagation, all hatchery-reared fish from this brood that are planted in Issaquah Creek will be marked. Hence if the 1940 brood returns in 1944, a comparison can be made between the hatchery-reared marked fish and the naturally-reared unmarked fish.

Two problems remain to be solved in the future: First, to determine the ability of the transplanted fish to propagate and maintain themselves naturally as well as artificially; and second, to determine why this planting has been so successful while many other similar experiments have been unsuccessful to an equal degree.

KING SALMON IN MAINE

On August 27,1940,a 33½-pound king salmon was caught in a trap near Pemaquid Point. On September 15, a 40-pound king was caught at the mouth of the Pemaquid River. A school of these large salmon estimated to be comprised of at least 50 fish, was playing about in the shallow estuary at the mouth of the Pemaquid River.

Scales from the 33½- and 40-pound salmon were collected by biologists and forwarded to the Cambridge laboratory of the Fish and Wildlife Service where they were examined by Dr. George Rounsefell. He reports that these two salmon were spawned in the fall of 1933 and may well have come from a shipment from the Pacific coast that was planted in Biscay Pond, several miles up the Pemaquid River, in 1934, for the purpose of providing fresh-water angling. They appear to have spent the summers of 1935, 1936, and 1937 in fresh water before escaping to the sea, as growth during these years was not very rapid. The summers of 1938, 1939, and 1940 were undoubtedly spent in the ocean as attested by the tremendous growth made during those 3 years.

As a result of the interest aroused by these salmon, it is likely that requests will be made for the Service to ship additional quantities of eggs from the West coast for further plantings. Because of the rather general unsatisfactory experience with transplanting exotic species, Service officials announce that no eggs will be transported for planting in East coast streams until the necessary biological studies have been made. Only if the studies indicate that ecological conditions are favorable, and that the probable survival rate is high, will further transplantation of Pacific salmon be considered.

THE NEW FEDERAL FISH DISTRIBUTION POLICY

REQUIREMENTS OF FEDERAL WATERS TO RECEIVE FIRST CONSIDERATION

By M. C. James, Assistant Chief
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Washington, D. C.

WHEN THE BUREAU of Fisheries and the Bureau of Biological Survey were merged in July 1940, to form the Fish and Wildlife Service, there was presented an opportunity to modify and improve policies and procedures which were in need of overhauling. Dr. Ira Gabrielson, the new Director, soon concluded, with the concurrence of the Fisheries side of the house, that the methods of disposing of the game and pan-fish production at the Federal hatcheries were eligible for a little polishing.

The views of several members of the staff were canvassed and pooled with the result that on November 26th Secretary Ickes approved the following statement of policy.

STATEMENT OF POLICY

It is the policy of the Fish and Wildlife Service to allocate or distribute the output of its fish hatcheries in the following order of precedence:

(a) Primary obligation will be in the stocking of waters on land under the control of the Federal Government, these including national parks, national monuments, national forests, Indian reservations, Bureau of Reclamation reservoirs, areas under the control of the Tennessee Valley Authority, wildlife refuges administered by the Fish and Wildlife Service, areas directly controlled by the Farm Security Administration or other agencies concerned with the relief of agriculture, and any miscellaneous waters controlled or administered by other Federal Government agencies. For the purpose of this policy, ponds, reservoirs, etc., which are constructed on private lands with the aid and encouragement, either financial or otherwise, of the Federal Government, shall be included in the foregoing category.

(b) Secondary obligation shall lie in stocking state waters, including the lakes, streams, ponds, etc., which are open to public fishing. This stocking shall be carried on either by direct plant under the supervision of the Service's employees, by arrangement with state conservation departments, or by furnishing the fish in response to applications submitted by responsible organizations or individuals.

(c) After apportioning the hatchery output to meet the above obligations, any remaining fish may be utilized in filling applications for private waters, this term to be construed as meaning lakes, ponds, or streams which are not open to the general public and which are not commercialized in any way.

The Old

The Service will continue to receive applications bearing Congressional endorsement as in the past. However, the Service will exercise full freedom of action in assigning species and determining the time and method of delivery. It shall be the Service's effort to cooperate as far as possible with the applicants and members of Congress who have endorsed the applications but the applications shall be handled in accordance with the priority set forth above. Giving special attention and service to applicants shall be minimized. Applications for trout and related species filed after March 1 shall be carried over for filling during the succeeding year unless there is a surplus of fish on hand. The comparable deadline for warm-water and pond species shall be June 1.

Applications which for any of the foregoing reasons remain unfilled at the end of two years will be automatically canceled.

The New

The principles which will guide the Service in its stocking activities seem fairly self-evident, but a little interpretation and explanation may not be amiss. First, the fish-application and the assignment of fish to non-public waters will still be with us. A fish-application, of itself, is not a pernicious instrumentality. Taken literally, as an "application" and not as a promissory note of the U. S. Government, it need not breed any of the evils which have been charged against it. There's many a mile of stream and many an acre of pond and lake which have never been recorded in any survey note-books and have never been classified in any stocking program. The local sportsmen,organized or as individuals, through the submission of their applications can be a vital agency in taking care of the stocking requirements of such waters until such time as the areas may be brought under management practices. These applications, shorn of their status as an obligation and subject to sound administrative judgment and discretion, will no longer keep the Federal hatcheryman on a production treadmill, but they will preserve the interest and support of the tax-paying sportsmen.

The first applications made their appearance in the late '70s and the early '80s when the Federal Government was proudly distributing its new-fangled European importation, the German carp. The latter has never been brought under control since that time, but the former is now due to assume a new and lesser niche in the scheme of things piscatorial. From this beginning, the application soon developed into the principal channel for distributing the increasing output of game and pan species. There was good reason for this, because fish were moved entirely by rail, and steel didn't always penetrate to the ultimate destination of fish. Some local agency was absolutely necessary to bridge this final gap. Essentially, therefore, the chief indictment of the fish application is the fact that it is a contemporary of those actual horse-and-buggy days. Angling is still a horse-and-buggy sport, thank the Lord, even though it has acquired some modern embellishments, and the time is not yet ripe for the complete banishment of that little piece of paper whereby the sportsman and his Government got together to preserve angling until Science could get around to tackling the same job.

Under this restatement of policy, Federal fish can go to waters which are not open to the general public. If such waters are commercialized, either directly or indirectly, the owners will have to look to commercial sources for their fish. Also, the freedom of administrative decision accorded by Secretary Ickes' approval of this policy will make it possible for Dr. Gabrielson to toss out to millionaire sporting clubs the gentle hint that fish can be bought like race-horses and yachts, and that Federal fish would be out of place in such exclusive surroundings.

This leaves us with the farmer and the small landowner, with a pond or creek on his property, and a distaste for having it fished out by hordes of fish-hungry anglers from distant communities. What excuse is there for giving him some fish produced at Federal expense? First, as a taxpayer he has contributed in some degree to the cost of producing these fish. Second, his waters are usually accessible to a not inconsiderable group of his friends and relatives, and the pressure on the heavily fished public waters is correspondingly reduced. His waters may frequently serve as a fish sanctuary or nursery and produce a surplus which may overflow into adjoining public waters. He may have constructed his ponds at his own expense and added materially to the impounded stored water reserve of the area. Nowadays we recognize that the man who does this is performing a public service as laudable as the planting of trees or the feeding of birds and game. Always retaining the right to head off abuses of the privilege, the Service therefore can render an indirect public benefit by reserving the right to stock certain categories of private waters when circumstances warrant.

Naturally in this shuffling of stocking objectives the Government dealt from the bottom and took care of its own requirements first. Federal land holdings are extensive, to express it with restraint, and as far as possible they are dedicated

to multiple use. These lands include some of the premier fishing waters of the nation, and many of them are readily subject to varying degrees of fishery management. Management plans cannot be fully realized unless there is a dependable supply of hatchery fish to be managed. At this time no one can say to what extent the strictly federal requirements will consume the output of the Federal hatcheries. However, the ever-increasing production of game and panfish will probably be sufficient to leave a generous quota to be placed in state waters to complement and supplement the programs which the states have devised. The entire policy presupposes that such stocking will be closely integrated with the state policies, where such exist.

If past comments may be taken as criteria, the PROGRESSIVE FISH-CULTURIST mailing list includes an inordinately high percentage of skeptics and "So What" guys. I can just hear some of them barking, "What's all the fireworks for? Fisheries is already doing everything that this so-called policy includes." That answer,my good colleagues, is so correct that it will win you a tube of shaving cream in any radio quiz program. Please note, however, that there is a vastly different emphasis in this restatement of priorities, as compared with previous practices in fish distribution. Swing bands and symphony orchestras use the same notes, but the difference in emphasis means the difference to the music lover between a headache and ecstacy. We are told that previous practices in fish stocking by the Federal Government have been productive of headaches in some circles. By a change of emphasis it may be possible to replace this with undiluted harmony.

In barely a half-hour's time and with only a moderately thick dictionary I've run down the ideal word to describe this new fish-stocking set-up as we visualize it here in the Fish and Wildlife Service. It's RE-ORIENTATION - that's what it is!

LICENSED ANGLERS IN THE UNITED STATES NUMBERED 7,858,275 in 1938-1939

During 1938-39, 7,858,275 sport fishing licenses and combination hunting and fishing licenses were issued to men, women, and children in the United States. Of this number, according to tabulations released early in December by the Fish and Wildlife Service, 5,481,376 were limited to fishing, while 2,376,899 included both hunting and fishing.

The total revenue from the sale of fishing licenses amounted to $10837168.28. New York State, with $1,151,687.63, led all other States in the amount of revenue received from the sale of fishing licenses; California was second with $746,142; Pennsylvania, third, with $614,734.25; Michigan, fourth, with $613,526; and Indiana, fifth, with $567,496.49.

Of the 7,858,275 fishing licenses sold during 1938-39, 7,111,545 were purchased by residents and 746,730 by nonresidents. Tourist fishing licenses numbered 294,246 in the thirty-four States where these are required; and more than 16,000 licenses were sold to children, and approximately 220,000 to women in those States where women and children are issued special licenses.

Figures for the 1938-39 season represent an increase of 422,098 licenses and $616,380 in fees over the 1937-38 season.

The 7,858,275 licensed anglers do not include all the anglers in the United States. An estimated 4,000,000 men, women, and children in the United States are exempt from license requirements, so that the total number of persons who enjoyed the sport of angling was probably about 12,000,000.

A BACTERIAL DISEASE OF CARP IN CENTRAL EUROPE

HAEMORRHAGIC SEPTICAEMIA CAUSES HEAVY LOSSES ON POLISH FISH FARMS

By Stanislas F. Śnieszko[1]
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Orono, Maine

FISH FARMING is an important part of agriculture in Poland as in other parts of Europe. The carp (Cyprinus carpio) is cultivated on a very large scale in artificial ponds and is the favored food of a large number of Europeans. All factors affecting the cultivation of carp therefore have considerable economic importance. As grown in Europe in ponds of stationary water, usually shallow and rich in organic matter, the carp is a prey of many animal and plant parasites. However, despite the fact that the growing of carp in Poland is a custom many centuries old, no records seem to exist which would indicate the appearance in the past of devastating infectious diseases.

During recent years, however, very serious epizoötics of carp were reported nearly simultaneously in Germany by Schäperclaus and in Poland by Spiczakow. The causative organism was believed to be Pseudomonas punctata, considered previously a harmless water saprophyte. The spread of the epizoötics was very fast in Poland, Czechoslovakia, and Germany. Many fish farms were faced with ruin because nearly all the fish died in the course of a few weeks. As in the case of all epidemics the first losses were the greatest. Every fish farm where the disease appeared for the first time lost nearly all its carp. This carp disease became, therefore, a very important problem and experts were invited to study the nature of the disease and to find a possible remedy for it. The author of this article was named chairman of a committee appointed by the Polish Government to investigate the disease. The committee's plan of work was as follows: (1) Isolation and identification of the specific organisms of the septicaemia isolated from all important fish farms in Poland. (2) Comparative study of the organisms isolated in Poland and surrounding countries. (3) Biological and serological classification of isolated strains of bacteria. (4) A study of the ways of spreading the infection. (5) Problems of immunity. (6) Methods of prevention.

Unfortunately, the committee had existed for only two years when the war of 1939 interrupted its activities. However, the results obtained even in such a short time were quite interesting and were similar to those obtained in Germany.

The symptoms of the disease are not always the same. The most frequently occurring symptom is the appearance of deep ulcers penetrating the skin and muscle tissue underneath. The ulcers are filled with bloody pus full of specific bacteria. Normally the infection is accompanied by the presence of bacteria in the blood and in all organs. The peritoneum is frequently inflamed and ascitic fluid is present. A large majority of the infected fish die. Those which survive

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[1]Formerly of Jagellonian University, Kraków, Poland.

recover in a few weeks,and the ulcers,if present, heal completely leaving slightly visible scars. Sometimes the fish, especially if they have been kept in winter storage ponds, may have no ulcers but show reddening of the abdomen mainly in the vicinity of the vent. One of the frequent internal symptoms of carp septicaemia is the strong inflammation of the mucous membrane of the intestine, which is covered by ulcers.

The disease may be acute or latent. In acute cases death occurs shortly after infection. The blood is filled with bacteria, but the other symptoms seldom appear. The rate of mortality varies from several to over 90 percent. The latent infection may show all above described symptoms or be entirely symptomless, in which case the only proof of the infection is the presence of specific bacteria in blood or organs. According to the observations of Schaperclaus and myself, it is possible that the "Rotseuche" of eels, of carp and even the furunculosis of trout may be caused by bacteria belonging to a closely related group of organisms.

Bacteria were usually isolated by seeding the media with the blood of infected fish. All fish with the symptoms of disease and many apparently healthy fish contained bacteria in the blood. The biological characteristics of the numerous strains isolated in Poland were similar to those isolated in Germany.

In order to study the serological properties of the bacteria, rabbits were immunized with suspensions of the different strains,and their sera used for cross-agglutination and cross-complement fixation tests. Those tests closely indicated that all tested strains could be divided into many serological groups. They were serologically non-uniform, a property which is characteristic also of bacteria from the Salmonella and Escherichia groups. Their biochemical properties, however, were quite uniform. These results were similar to those obtained by other Polish authors. Similar results were obtained also with bacteria from eels by Nybelin and others.

In another series of experiments carp were inoculated with killed bacteria and carp immune sera was used for agglutination tests by Pliszka. The carp immune sera were even more effective than rabbit sera and agglutinated homologous strains of bacteria in dilutions up to 1:40,000.

In regard to the immunization of fish, a very interesting fact was described by Nybelin in connection with his bacteriological studies of eels. He discovered that if the eels were kept in cold water, about 47 to 49° F., the antibodies were not formed and the eels could not be immunized. When, however, the temperature of water was raised to 63 to 65° F., the eels produced within three weeks very strong and specific antibodies. Similar experiments were made by Pliska with carp. Carp kept in cold water (49 to 52° F.) did not produce antibodies even after 9 weeks subsequent to injection of bacteria. Those carp, however, which were kept in warmer water (65 to 69° F.) produced within three weeks agglutinins with the high titer up to 1:40,000. Also, carp held for many weeks in cold water and later transferred to 65 or 70-degree water developed strong immunity within 3 weeks without any additional injection of bacteria.

These results are of considerable practical importance. They indicate that: (1) Carp can be used to produce strong agglutinating sera, (2) can produce active immunity, the degree of which can be estimated and used for epidemiological experiments, and (3) the production of immunity is closely correlated with the temperature of the water in which the fish live. The last fact especially is of great importance and helps to explain why the greatest outbreaks of disease were reported mainly in early spring. In summer when the temperature of the water was favourable for the production of immunity, only a few fish died from infection.

The greatest outbreaks of infection occurred most frequently, as far as could be ascertained from our observations, when the fish were transferred from cold

water in deep winter storage ponds to shallow summer ponds with much warmer water. We explained it by assuming that the bacteria were able to multiply and infect the fish before the fish had time to produce the immune bodies. The infection occurred most frequently in May and in two or three weeks had run its course.

The discovery that the different strains of Ps. punctata belong to different serological groups has another important practical meaning. It indicates that fish that have acquired immunity to one or even several strains of bacteria are not necessarily immune to other serological types. It has been reported both by Polish and German authors that if a certain fish farm had an epidemic of septicaemia the fish which survived were quite immune to reinfection with the same disease. If, however, fish were introduced from another fish farm, or sometimes even from other distant parts of the same but large farm, both fish immune to that form of bacteria, and newly introduced fish would suffer from a severe infection. This fact suggests that fish in each farm are immune only to its own, homologous, strain of Ps. punctatus, and so if we transfer fish from farm to farm a cross-infection will occur and all the fish may become diseased. Occurrences of this type were repeatedly reported and the explanation above outlined seems to satisfy the facts, even if it is not the only one possible within the laws of epidemiology.

As mentioned above,fish could be artificially immunized to produce a specific antibody. Both in Poland and in Germany studies were made to determine whether it would be possible to immunize fish by vaccination as is done with great success with other domestic animals. Preliminary experiments conducted at the Experimental Fish Farming Station in Krakow, gave interesting results. A number of fish were immunized by a single intraperitoneal injection of a suspension of killed bacteria. Fish were kept at a temperature of 65 to 68° F. Three weeks later part of the fish were inoculated subcutaneously with the homologous strain of living virulent bacteria. Some fish received a dose of bacteria just large enough to cause a fatal infection, and some received a dose several times larger. From those fish which were infected with an excessive dose of virulent bacteria 100 percent of those not immunized died, and 40 percent of those immunized. From those which were infected with barely a lethal dose of bacteria 80 percent of those not immunized died, and 20 percent of those immunized. Schaperclaus immunized about 3,000 fish which were afterwards exposed to natural infection. From the fish immunized in the fall, 20 percent died from infection, and over 40 percent of the fish not immunized died. From those which were immunized in the spring, 7.1 percent of those immunized died, and 17.6 percent of those untreated control fish.

These preliminary results obtained were so encouraging that several of the owners of the leading Polish fish farms put at the disposal of the committee a large number of fish and ponds for experimental purposes. In the spring of 1939 over 100,000 fish, one and two years old, received intraperitoneal injections of the strain of Ps. punctata isolated from the blood of the fishes of the same farms a few weeks before. For the sake of comparison both inoculated and control fish were kept in the same ponds. The war of September 1939 disrupted all those experiments organized on such a large, never-before-contemplated scale.

Other experiments undertaken by some progressive fish-culturists with the collaboration of the Committee indicated that the methods of treating ponds and feeding fish also had a considerable influence on the rate of mortality from the infection.

The study of the haemorrhagic septicaemia of carp is far from being satisfactorily concluded. In the present stage of our knowledge we feel qualified only to make some suggestions on how to minimize the losses from this serious infectious disease of carp.

1. It is advisable to avoid introduction of fish of any age from other fish farms regardless of whether they are infected or considered free from infection.
2. The fish should be transferred from winter ponds to summer ponds early in the spring in order to avoid rapid changes in temperature.
3. Ponds should be kept in sanitary condition by drying and freezing out the summer ponds. If possible change them once every few years to fields sown with crops.
4. Fertilize the soil of the ponds if possible.
5. Keep fish as free as possible from parasites which make them weak and less resistant.
6. Do not overfeed the fish, and do not feed at all when sick (inflamed intestines).
7. The winter storage ponds should not be overstocked with fish, and should be well ventilated and have a clean sandy bottom.
8. Keep the winter ponds dry, treat them with lime, or even cultivate them during the summer.
9. If possible select the spawn fish from those fishes which successfully withstood infections.

Wunder in Germany suggests the exposure of fish to infection, during the first year of life, when they are believed to be more resistant to septicaemia. When exposed to infection all fish not resistant enough will die and prevent the loss during the next two years of growth, when the value of the fish is much greater.

The value of active immunization of fish by way of injections of killed suspensions of bacteria should not be overestimated even if the preliminary experiments indicated its value. Before any final judgment can be passed about the practical application of artificial immunization, further experiments should be made on a large number of fish, and under varying conditions. The cost of immunization does not seem to be prohibitive under European conditions, if satisfactory results were assured.

LAKE HURON WHITEFISH CONTINUE TO DECLINE

Lake Huron whitefish, the most valuable food fish in the lake,may be destined to follow other Great Lakes species into commercial extinction, according to records compiled by biologists of the Fish and Wildlife Service. During 1939 the American waters of Lake Huron yielded 255,000 pounds of whitefish--only 46 percent of the 1938 catch of 558,000 pounds. The 1938 catch was only a little above the all-time low annual catch for the lake.

Introduction of the "deep trap net" in 1929 is considered responsible for the present decline in abundance. This net, equipped with a cubical lifting crib or pot as great as 50 feet on a side, could be set in waters more than 120 feet in depth, and could be moved readily from place to place in order to fish wherever whitefish were more abundant. Since 1934, following peak yields in each of the six fishing districts in Lake Huron where the deep trap net was used, the whitefish fishery of the entire lake has continued to decline. The use of the deep trap net was restricted by Michigan law in 1935 to waters less than 80 feet in depth. The new regulation, however, brought no improvement in the fishery, probably coming too late to halt the decline.

AIR CONDITIONING FISH DISTRIBUTION TANKS

By Ralph H. Olson
Fish and Wildlife Service
Las Vegas, Nevada

THE DISTRIBUTION of fish from the Service's Las Vegas, (Nev.) station presents many problems. The great distances that must sometimes be travelled and the excessive temperatures encountered in this desert-like country, where the air temperature varies from 90° to 118° in the shade, require special care to provide the proper temperature and aeration of the water during the transportation of fish.

In an attempt to maintain acceptable water temperatures and to increase the aeration of the water we have developed a funnel-like arrangement that circulates a column of air through the water jets. The evaporation of some of the water cools the remaining water and maintains an equal temperature.

The distribution tank in use at this station is 2 by 3 by 5 feet, inside dimensions. The water is circulated by a 1½-inch Dual Prime pump operated by a one horse-power engine (fig. 1). The water is drawn from the bottom of the tank and discharged with considerable force from small jets in the delivery line. The funnel arrangement for aerating the water is installed over the top of the cab with a 3-inch pipe leading to the tank. The tank is covered completely with a tight fitting lid with the exception of a slot-like opening 3 by 18 inches in the back part of the cover. With the truck in motion the air is thus collected by the funnel and diverted by the pipe into the covered tank, where it passes through the spray streams of water,to be finally exhausted through the opening in the lid. The entire transportation unit is so constructed that it fits in the back of a ½-ton pickup truck.

An experimental run of 100 miles was made with the truck travelling at a speed of 45 miles an hour and the water circulating by the pump just as it would be on a regular planting trip. The temperature of the water was recorded every 25 miles. A similar test was conducted with the tank filled with water and the pump running, but with the truck stationary. Under these conditions no air was forced through the ventilator system. The temperatures were taken every 35 minutes in the second test. The results of the two tests are summarized as follows:

Table 1. A comparison of water temperatures in fish-distribution tanks with and without funnel ventilator in operation.

Running Test			Standing Test		
Distance	Temperature (°F)		Time elapsed	Temperature (°F)	
run (miles)	Air	Water	(minutes)	Air	Water
0	114	77	0	116	77
25	---	78	35	---	82
50	---	78	70	---	85
75	---	78	105	---	86
100	112	78	140	112	88

We have used the air circulating device on our distribution tank to transport 120,000 bass, the trips totalling some 2,000 miles. During these trips we

Fig. 1. While the truck is in motion, the funnel ventilator collects air and circulates it through the water jets.

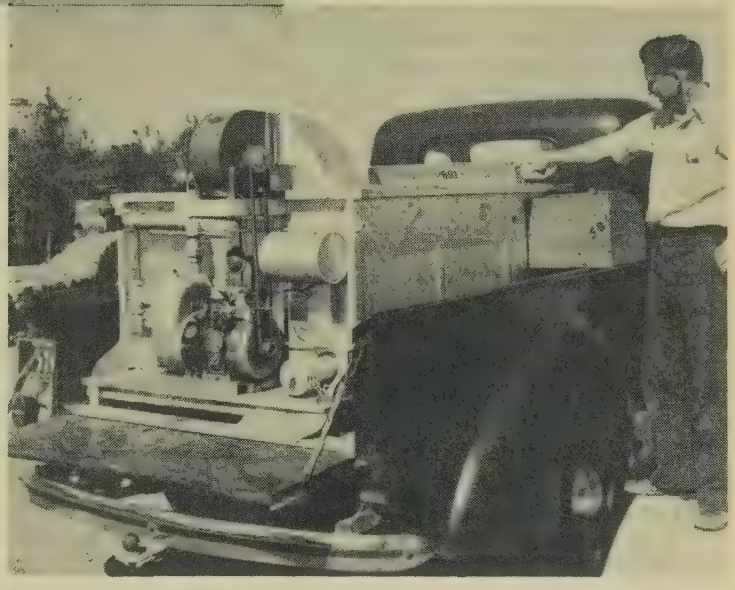

Fig. 2. A blower mounted above the pump motor forces air through the water sprays and operates whether the truck is standing or running.

did not use ice for cooling, although the air temperatures ranged from 90° to 118° F. Our fish mortality during this transplantation work was very small.

A second method of introducing the air flow has been devised, using mechanical power to force the air through the water sprays (fig. 2). A single width, 6-inch, squirrel-cage type of blower was mounted above the motor used to drive the water pump. A V-belt connected the blower to the motor drive shaft to provide the power for the blower operation. The blower was in turn connected to an air duct that led the air into the spray chamber above the water. The air was diverted forward through the water sprays and exhausted through an opening in the forward end of the tank.

This mechanical method of forcing the air through the water sprays has the advantage of cooling the tank water while the truck is at rest as well as during the period of time when the truck is travelling along the highway. It also produces a uniform air flow throughout the spray chamber at all times, while the flow of air introduced by the funnel mounted on the cab varies with the velocity and direction of the wind and the speed travelled by the truck.

FEEDS FOR THE FISH HATCHERIES

A SUMMARY OF RESEARCH AT THE CORTLAND EXPERIMENTAL HATCHERY[1]

By C. M. McCay and A. M. Phillips
Cornell University
Ithaca, New York

SINCE 1927 RESEARCH has been in progress at the Cortland Experimental hatchery to develop improved feeding mixtures for use in the trout hatcheries of America. Each year an annual summary of results is published. These can be obtained by writing the New York Conservation Department, Albany, New York.

The Cortland Hatchery is operated in two sections. The first consists of about fifty small troughs for feeding trials with small numbers of trout. Usually fifty to two hundred trout are carried in each trough. This makes it possible to test a great variety of feedstuffs. Connected with this unit is a well equipped chemical-physiological laboratory for biochemical studies. Here work is in progress concerning the digestion and absorption of various components of feed such as starch and fat.

In addition to the unit for small scale studies a second hatchery is operated on a production basis. This serves as the final testing unit before diets are ready to be tried in the regular producing hatcheries. From this unit about a half million trout are sent out for stocking purposes each year.

From the beginning the chief purpose of our studies has been to cheapen the feed costs and improve the feeding practices. In general about half of the work has been devoted to problems of developing better mixtures of feedstuffs. The other half of the work, which is of much greater practical value in the end, has consisted of building a scientific background for establishing the nutritional requirements of trout.

In general the average person is badly confused in thinking of the nutrition of trout and the problems of the hatchery. The ordinary person says, "I feed my goldfish little or nothing. Why can't you operate a trout hatchery on the same basis?" This person forgets that the difference between a trout and a goldfish is as great as that between a cat and a cow. The trout can only live in very cold, well-oxygenated water. The goldfish thrives in a heated room. The trout has a very short intestinal tract. The goldfish has a long one like a sheep. These are only a few of the differences. The nutritional requirements of the trout are entirely different from those of the goldfish.

FAILURE OF TROUT FED USUAL DIETS

In discussing the results of our studies with trout it may be well to stress a series of failures because they teach an important lesson. Every year since

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[1]Address delivered at the Nutrition School, Cornell University, October 17-19, 1940.

1927 we have made an attempt to rear trout upon diets that are complete for the rat. We have always failed. You can prepare a mixture of all known vitamins, protein, fat, carbohydrates and minerals so that a rat will thrive, but the trout dies almost as quickly as it will with no food. In other words there are unknown substances that are needed to satisfy the nutritional requirements of the trout. Very early we appreciated that these factors are present in fresh meat but deficient in meat which has been dried in any ordinary manner. The only meat which does not lose this factor is that which is dried while still frozen. Thirteen years ago we termed this unknown substance "factor H." We have made many attempts to isolate it but have always failed. The only one of the warm blooded animals that may require this factor is the mink, since no one has been able to rear this species without fresh meat.

PROTEIN FROM FRESH MEAT IS ESSENTIAL

The protein requirement of the trout has been determined several times. About fourteen percent of a good protein such as that from meat seems adequate for good growth. This is fourteen percent of the calories in the diet. This protein can be supplied from several sources but part of it must come from fresh meat to provide the unknown factors. Dried skimmed milk, dried buttermilk, peanut meal, cottonseed meal and fish meal are suitable protein sources. For practical purposes equal parts of dried skimmed milk, cottonseed meal and white fish meal are often mixed together and fed after the addition of an equal weight of fresh meat.

HOW TO FEED DRY MEALS

A special problem that arises in feeding dry meals in the hatchery is the pollution of the water by small particles of the mixture. Two developments have partly corrected this difficulty. The first consists of blowing the fresh meat and dry feed through a fan so that a product that looks much like saw dust is available for feeding. This was developed on the west coast. A second method was discovered at Cortland. This depends upon the unique property of raw spleen of forming a glutinous mass when ground and allowed to stand with two percent of its weight of salt. No other meat is known to have this property. This glutinous mass can bind feedstuffs so that the water pollution is much reduced and the trout can eat most of the feed. The increased use of spleen in feeding trout has led to some special problems which will be summarized a little later.

FEEDING COTTONSEED AND LINSEED MEAL

In trout feeding large amounts of cottonseed meal can be used. Dry mixtures containing as much as 45 percent cottonseed meal have been tested. In contrast, such a valuable feedstuff as linseed meal cannot be fed to trout. For some time we studied linseed meal because it has the special property of forming glutinous masses like salted spleen. However, trout are quickly poisoned by linseed meal due to its content of glucoside, which probably sets free hydrogen cyanide very rapidly in the trout's gastro-intestinal tract. Several methods were used for removing this cyanide from linseed meal, but the meal lost its glutinous properties at the same time. Fish such as bullheads are not poisoned by linseed meal, showing the contrast between species.

TROUT UTILIZE CALCIUM IN WATER

Over the years we often wondered why trout were little benefited by supplements containing calcium and why trout did not get rickets when fed a diet of

meat alone. This was explained after a series of basic experiments. Representative samples from groups of trout were analyzed at the beginning and end of a feeding period. In the meantime they were fed upon a meat diet and this was analyzed. From the difference in composition of the trout bodies at the beginning and end of the study, it was evident that most of the calcium had not originated from the food, since this was meat. The calcium had come from the water. The trout either drinks its calcium or absorbs it through its gills. No one knows what the trout does in soft waters containing little calcium. Under such conditions calcium should probably be included in the diet. At least a trout does not seem to get rickets.

MEAT PRESERVATIVES

Many attempts have been made to use preserved meats in feeding trout. If meat must be fed, the economical operation would consist in grinding at some central point, adding a preservative and shipping in barrels or casks to the hatchery. Under such conditions much grinding and refrigeration equipment could be dispensed with at the various hatcheries. Furthermore advantage could be taken of buying meat during periods of favorable prices. Moderate amounts of formaldehyde can be used. Thus meat can be stored in 1 percent formalin for long periods and then fed to trout without apparent injury. Thus far we have never pushed this method into practice because we have hoped to develop still better methods. Among the preservatives we have tested is hydrochloric acid. This suggests itself because this acid is already present in the stomach of the trout as it is in the stomachs of higher animals. Furthermore if meat could be preserved with this acid and neutralized with sodium carbonate just before feeding we would end with a mixture of meat and salt. However, long-time storage with acid partly hydrolyzes the meat and converts it into a soup that is no longer very useful in mixtures.

BALANCE AND DIGESTION TRIALS

Both chemical balances and digestion studies have been made with trout. These have indicated clearly that cooked starch is utilized more effectively than raw starch, but even a considerable fraction of the raw starch is digested and absorbed. Sugars such as glucose and sucrose are well utilized by the trout. Fats can be digested and absorbed,but higher melting fats are utilized with some difficulty due to the low temperature of the water in which the trout swims. Many long time studies of the growth rates of trout have indicated that they grow as long as they live. Our studies have covered periods as long as five years. The growth rate of the trout differs from that of higher animals inasmuch as its body increases by a constant percentage during each week of the growing period. As everyone knows, the growth rate for warm blooded animals decreases as the animal grows older and larger.

THE STORAGE OF VITAMIN A

The latest developments may be of interest. Some years ago a biologist studied trout that seemed to have developed a type of cataract. These trout had been fed chiefly upon spleen at one of the state hatcheries. Cod liver oil, when included in the diet, failed to prevent or correct this condition of the eyes. Therefore this condition was not considered a deficiency of vitamin A.

During the past summer we developed a micro-colorimetric method for measuring approximately the vitamin A content of very small amounts of tissues. Using this method, the distribution of vitamin A in the body of the trout was first determined. Near the lower opening of the trout's stomach one observes the caeca

which are a bunch of thirty or forty fingerlike pouches. To the fisherman they look like strips of fat attached to the stomach and small intestine. In these caeca the trout carries most of its vitamin A. Here one finds about four times as much as in the liver,which is the other important organ for storage. In studying trout fed different diets we were amazed to discover that those fed spleen had very little vitamin A in their storage depots, while those fed liver had rich supplies. In other words, spleen-fed trout are probably suffering from vitamin A deficiency, and when placed in the streams may be unable to see their enemies or capture their food.

This agreed well with the earlier observation of the development of cataract in trout fed spleen, but it raised the question of the ineffectiveness of cod liver oil in checking this trouble. To study this, seven groups of trout were segregated. These had been fed spleen previously and their body stores were very low in vitamin A. One of these groups was changed to a diet of beef liver. In the course of 3 or 4 weeks the body stores of vitamin A increased markedly. Three other groups were fed different levels of carotene dissolved in oil. They have shown only very slight increases. Three additional ones have been fed different levels of cod liver oil. They have shown no storage of vitamin A. No explanation for these results can be given today. Apparently the trout can only utilize vitamin A in some special form such as that in beef liver. The source of this vitamin A under natural conditions is unkhown.

In addition to studying vitamin A at the hatchery we are studying an anemia that develops in trout when they are fed diets lacking fresh meat. Under such conditions trout become very anemic and finally die. At present we are testing the various liver extracts used in treating human anemia to see if these are effective in this special case. This field may lead to new advances in human medicine.

This brief review of some of the operations at the Cortland hatchery may give a better insight into the problems that confront the nutrition worker in some of the special fields.

10,000 CHANNEL CATFISH STOCKED IN DELTA VALLEY

Ten thousand channel catfish, native to lowland streams of Texas, are now wintering in waters near Delta, Colorado, as a result of recommendations made by aquiculturists of the Fish and Wildlife Service.

In response to sportsmen's requests, Service biologists were assigned over a year ago to make studies of the Gunnison and Uncompahgre rivers and their tributaries. They found a number of streams and reservoirs in the lower altitudes of the western slopes suitable for stocking with warm-water species. Channel catfish seemed a suitable species to import, although this is one of the most difficult of the warm-water species to propagate under artificial conditions. Because importation from Mississippi and New Mexico to similar waters had been tried previously without success, it was determined this time to use robust, fingerling fish, available in quantity at the Service's hatchery in Forth Worth, Tex. They were shipped in special tank trucks to another Service hatchery at Santa Rosa, N. Mex. The Colorado Game and Fish Commission picked them up at that point in mid-November for distribution in nearby Delta waters.

The entire project is another step in connection with the Service's continuing development of a system of fishery management throughout the United States, which includes the establishment of research and demonstration centers in each of the nine National Forest regions, each to be under the supervision of skilled aquatic biologists and their assistants.

THE HATCHERY LOG

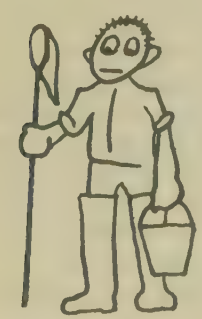
Anonymous

SUPERINTENDENT'S official entry: Two apprentices cleaning ponds and mowing lawns. Fish-culturist feeding fish and treating for disease. Foreman assisting in general work. Superintendent engaged in direct supervision over work and in handling all office routine. No unusual work undertaken.

Following are personal entries as they might have been made by various employees. Opinions expressed are entirely intentional and any similarity to persons living or dead is no coincidence. If the shoe fits, put it on.

JUNIOR APPRENTICE FISH CULTURIST with service of one year: Today was just another day. At work at eight but couldn't do much for a half hour because the Superintendent was cornered by a sportsman. I've tried several times to fill in spare moments like this with work of my own choosing, but I found out soon enough there is apparently nothing I can do correctly on my own initiative. So I've stopped that. Today at lunch Mary asked me why I have lost all the spirit and ambition I had a year ago when I stepped into this job. Guess the continual frustration can be blamed. If I don't watch out I'll be like Joe, still an apprentice after 10 years, and not caring much about anything -- and he certainly has learned to keep his new ideas to himself. I told him he should ask the Superintendent if he could try them out. He just laughed and said, "You'll learn." I know what he meant.

Well, the day passed as usual. I've done a lot of odd jobs but, as has come to be natural, I have an empty feeling. Really, there wasn't one thing that I actually did myself without being told. But if that's the way they want it,O.K. Not to my liking but guess I'll have to stay in line.



APPRENTICE FISH-CULTURIST of 10 years' service: Received notice today that I have been promoted to fish-culturist - at no increase in pay. However, deduction for quarters will be increased from $5.00 to $10.00 monthly. That's just dandy. Actually a $5.00 monthly decrease in pay. Sarah won't like this news,and it will start her on another tirade against the Fish Cultural Service. I can't help but resent her words. Why, I don't know.

Got myself into a jam today for the first time in months. Undertook to cut a new screen for one of the ponds. Last time, I took it upon myself to set up the blade on the power mower. I should know better. Such important and delicate problems, we all have learned, must be called to the attention of the Superintendent.

Well, anyway, after ten years I'm Fish-culturist. Somehow it doesn't mean much. The way things are now I'll be no better off. I no longer have a mind of my own. The pay increase which is expected with a promotion didn't materialize.

FISH-CULTURIST with 5 years in the position: Yesterday left at 3 a. m. with a load of fish and returned at 11:00 last night. Had a little tire trouble and the governor on the truck wouldn't let me get up enough speed to make any hills in high. Today asked the boss for travel order but he said it was only a one day trip. Sure, only eighteen continuous hours, and three meals I had to buy, and a couple of stops for coffee to keep awake.

Noticed today that some of my young stuff was twirling and loss going up so told the boss. He asked me how much food I'd be feeding and then gave me some calomel to mix in. All I know is that calomel is supposed to be good for Octomitus, but he never tells us how much to a certain amount of food. The station library, such as it is, isn't much good to us -- scattered pretty well, and all ancient stuff. We never get and never see, any new publications. Wish I had the cash to buy some of the few fish books that come out.

The boys didn't trim the meat very well last time, and the boss noticed and gave them the devil. George didn't take it very well. Not that I blame him, but he forgets the boss makes out conduct and efficiency reports, and we can lose pretty fast that way.

FOREMAN: Heard today that the Superintendent is to be transferred. Maybe, now, after these years I'll get a crack at the top job. Right now I'm afraid I couldn't swing it. And he'll probably tell the big shots that I can't. Well, in the four years I've had this job I've been in the office for not more than one hour a month. The boss feels that the official mail and all reports he alone can take care of properly. I have always thought that a successful business continues to operate successfully only if assistants are taught the work of the next highest position so in any event there will be some one who knows procedure. But here, it's a cinch, if the boss is transferred or gets sick I'll be holding the burlap. I don't know a thing about the office work, and I'll probably not get the job. But what can I do?

I've got to figure some way to get the boss to teach me the office work, and in a hurry. I know it's not tough even if he tries to give the impression that his problems are complicated and very, very important.

DISCUSSION BY DISINTERESTED PARTY

Disinterested Party: It appears that some of the employees are pretty much under the thumb. That is the main theme. Is this a general condition?

A: By all means, No. But there are instances where some things similar to those mentioned are daily occurrences.

D. P.: If that's the case, just as one of your writers intimates, these fellows at the stations, who would normally be expected to strive and eventually learn the ropes and then step up, are actually having their initiative destroyed, and probably have given up completely.

A: You've hit it right on the head. If such conditions become at all general any good organization would be ruined in a few years. There would be none to take over the reins when the "tops" retire.

THE NEW SALMON HATCHERY AT LEAVENWORTH

By S. E. Hutton
Bureau of Reclamation

Reprinted from The Reclamation Era, December 1940.

AN INSTITUTION, which Supervising Engineer Frank Banks calls the Bureau's fish college, is in operation at Leavenworth, Wash., for the salmon and steelhead classes of 1940-41. Its purpose is to teach future generations of the tribes of migratory fish that formerly spawned above the Grand Coulee Dam to perform that function hereafter in tributaries of the Columbia River below the dam, because that huge structure makes it impossible for the matured fish to reach the upper tributaries, and would offer a fatal hazard to the downward migration of the resulting offspring.

Since the salmon, the important commercial fish to be considered, returns, usually at the age of 4 years, to spawn in the shallows of the stream in which it spent its early free life before migrating to the sea, the offspring of fish which were native to streams above the Grand Coulee Dam must be planted in tributaries lower down, so as to establish there the spawning grounds for themselves and their descendants. This involves the operating of traps in the Columbia River at the Rock Island Dam, 150 miles downstream from the Grand Coulee Dam, and of a large plant at Leavenworth, to which adult fish, bound upstream to spawn, are hauled in tank trucks.

The essential features of the plant at Leavenworth are holding ponds, in which the fish reside until they ripen for spawning; a hatchery wherein eggs are placed in troughs and hatched; rearing ponds, in which young fish are bred to various ages before being released, in order to reduce the mortality rate, naturally incident to the release of freshly hatched fry, and facilities for furnishing water to the plant in required quantities and at proper temperatures.

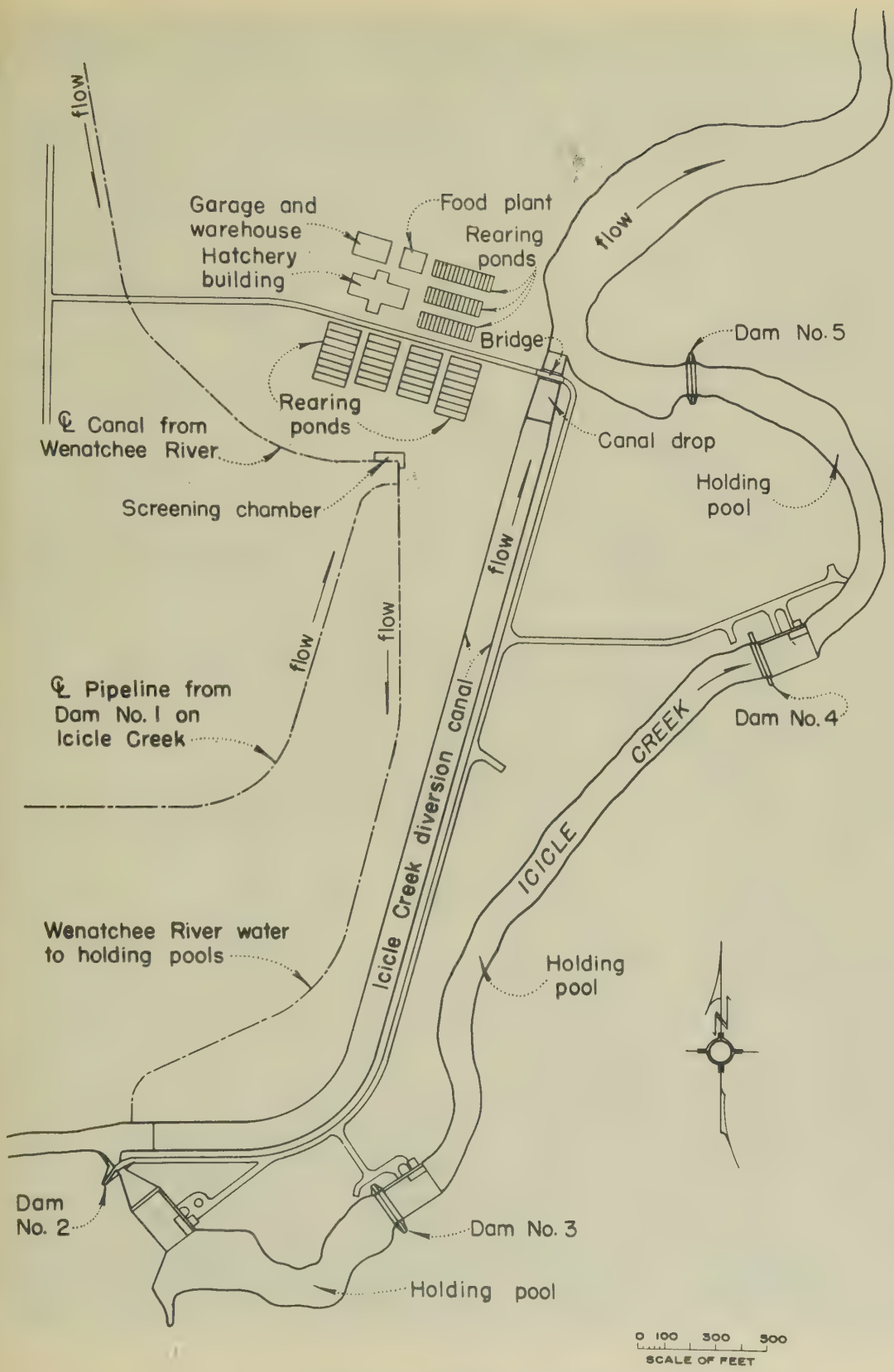
The holding ponds have been formed in the channel of Icicle Creek, about 2 miles south of Leavenworth, Wash., by building four dams across it. The uppermost of the four, known as Dam No. 2, regulates the flow of Icicle Creek through the ponds, and diverts any excess water through a canal 4,085 feet long to a point in the creek channel below Dam No. 5. Each holding pond contains a deep and a shallow section, the former for the salmon to rest in prior to spawning and the latter where they can be readily captured by seine net when they move into shallow water to commence spawning.

BUILDINGS

The hatchery plant, located on the left bank of Icicle Creek just below the holding ponds, includes in its group of three main buildings a hatchery building with a hatching room 88 feet wide and 225 feet long. Two two-story wings, 36 x 45 feet in plan, provide space for office, laboratory, storage rooms, recreational space for employees, and reception and rest rooms for visitors. A combined shop, garage, and warehouse building, one story high and 142 feet 8 inches long by 89 feet 8 inches wide; and a third building, 67 feet 8 inches by 96 feet 8 inches in area, to house central-heating equipment, refrigeration apparatus, food-grinding machinery, and cold-storage rooms, complete the building group.

Adjacent to the hatchery building are two groups of rearing ponds, one containing 30 ponds 30 feet wide and 130 feet long, and the other 40 ponds 18 feet wide and 76 feet long.

The water supply for the plant is derived from Icicle Creek and the Wenatchee River, and will be supplemented at certain times, particularly in winter, with



LEAVENWORTH STATION

MIGRATORY FISH CONTROL
COLUMBIA BASIN PROJECT

water from wells. Ordinarily, the minimum flow of 100 cubic feet per second through the holding ponds will be taken from Icicle Creek, through Dam No. 2, but it will be possible to admit,through this dam, additional water from the Wenatchee River.

Dam No. 2 serves to divide the flow of Icicle Creek between the holding ponds, formed in the creek channel, and the diversion canal, which begins above the dam and ends in a junction with the creek channel below Dam No. 5. Dam No. 2 was built across the channel of Icicle Creek. It is a reinforced concrete structure, roughly 20 feet high,exclusive of cut-off walls, 38 feet long, up and down stream, and about 36 feet wide. Water is admitted to the holding ponds through two openings in the concrete, 16 feet wide and 5 feet high, at the bottom of the channel, each opening controlled by a radial gate. The water level above the dam may vary from elevation 1,124 to 1,140. Below the dam, in the upper holding pool, it will be, normally, about elevation 1,123.

Below Dam No. 2, the flow broadens from 34 to 143 feet, and issues through a diffusion structure into the upper spawning bed. The diffusion structure is a weir so arranged that water flowing through it is directed downward into a pit, from which it rises through a diffusion grating into the next pool. If the water fell from one pool into the next, the fish would damage and exhaust themselves in fruitless attempts to scale the weirs.

Below this diffusion structure is a spawning bed about 135 feet wide and 197 feet long, the bottom covered with pit-run gravel and sloping 6 inches in its length. In the lower left-hand corner of the bed is a seine-landing platform, 81½ feet long and 25 feet wide, in front of a spawning shed, 32 feet wide and 36 feet long.

An 11-foot flume extends along the left side of the spawning bed, from the rack at its lower end through a trap entrance at the diffusion structure. About midway of its length is an elevator, by means of which steelheads, after spawning, can be loaded into tank trucks for distribution to streams, since they do not end their life cycles with spawning as do the blueback and chinook salmon. Roads are provided for access to all structures.

Dams 3, 4, and 5 are similar in design to the diffusion structure below Dam No. 2, and they serve the same purpose; but, in addition, they also maintain, by means of stop logs, the 3- or 4-foot differences in the water levels between successive pools.

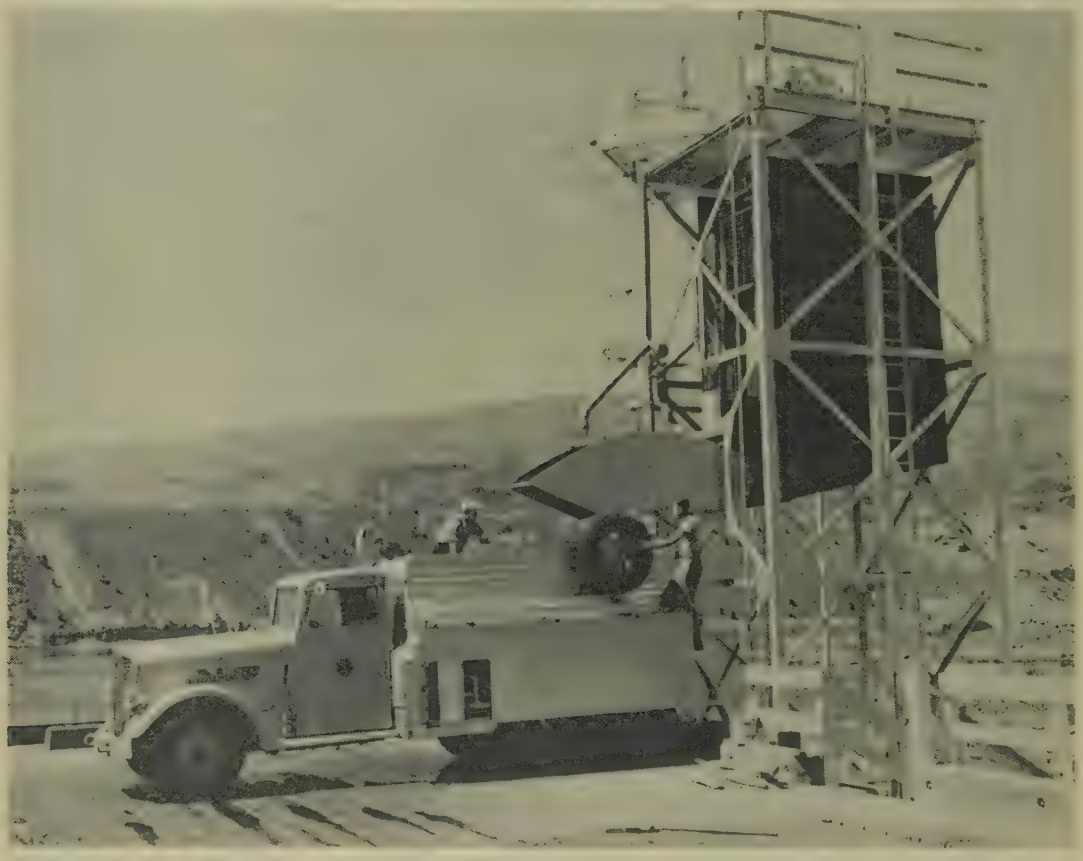
DIVERSION CANAL

The Icicle Creek diversion canal or wasteway is 115 feet wide on the bottom, with slides sloping 2 to 1. The bottom and left bank were covered with a 12-inch layer of coarse gravel, and the right bank, along the creek, was riprapped with rock taken from excavations. The canal is 17.45 feet deep, and, with a water depth of 14.45 feet, will carry 10,000 cubic feet per second, twice the maximum recorded flow of Icicle Creek.

The diversion canal drops only about a foot in its 4,085-foot length, leaving a difference of 10 to 12 feet between the bottom of the canal and the water level in Icicle Creek below Dam No. 5. Connection between the diversion canal and the creek channel is made through a concrete outlet structure 210 feet long. In the upper 40 feet of the structure, wing walls reduce the width of the channel to 100 feet, and an apron slopes up from the canal bottom at elevation 1,124.65 to a crest at elevation 1,129. From that point, the channel is reduced to 80 feet in width, and falls 22 feet in elevation in 130 feet, to a second apron 40 feet wide and provided with dentated sills to reduce the velocity of water discharged into Icicle Creek. A steel highway bridge spans the outlet structure at its lower end.

The Leavenworth Hatchery, located in the foothills of the Cascade Mountains, appears in the center. To the right of the hatchery are the Icicle Creek diversion canal and Icicle Creek. The Wenatchee River Canal winds across level ground from the left background toward the hatchery.

Water for the hatchery and rearing ponds is available from Dam No.1 in Icicle Creek, three-quarters of a mile upstream from Dam No. 2, through a 6,635-foot pipeline, and from the Wenatchee River through a 16,000-foot canal. The pipeline and canal meet at screening chambers near the hatchery. There, entrained debris is removed, and the water can be mixed in any ratios necessary for temperature control. A system of pipes extends from the screening chambers to the hatchery and rearing ponds, and an extension of the Wenatchee Canal bypasses the screening chamber and intersects the Icicle Creek diversion canal near Dam No. 2. At



Loading fish-transportation truck at trap, Rock Island Dam.

that point, the bottom of the canal is low, so that water from the Wenatchee River can supplement the Icicle flow through Dam No. 2, in case it alone is insufficient for the fish in the holding ponds.

The handling of the water supply to the plant is governed by the requirements for keeping the adult fish in healthy condition and for controlling the hatching time, and by the flows and temperatures of the three water sources.

Although salmon, in their migration from the sea to spawning grounds,can safely spend short periods in relatively warm water (75° F. to 80° F.), they are accustomed to and remain healthy only in cool water. In the holding ponds, where adult fish may be held several months while ripening, the temperature range cannot be great, and temperatures cannot be high if heavy mortality is to be avoided. Ideal conditions would be realized if, in the holding ponds, there could be duplicated the conditions that exist in deep pools near the sources of streams, where

Upper left: Seining platform and holding shed.
Upper right: A 16,000-foot canal brings water from the Wenatchee River.
Lower left: Interior view of the Leavenworth Hatchery.
Lower right: Dam No. 2 — diversion canal to left, holding ponds beyond.

the fish await the spawning season. Experiments have shown that water temperatures up to 62° F. are satisfactory in holding ponds, but that temperatures above 65° F., if long sustained, are dangerous.

Hatching time varies with temperature, and can be controlled quite closely, higher temperatures shortening the incubation period. Preferred hatchery temperatures range from 39° to 52° F. In rearing ponds, water temperatures between 52° and 65° F. give satisfactory results.

The water supply from Icicle Creek varies in temperature from 32° in winter to 63° in late summer, and that from the Wenatchee River from 38° or 40° in spring and fall to 70° in summer. The well water temperature is practically uniform at 50°.

A flow of 160 second-feet is available from the Wenatchee River, 6 second-feet from wells, and 20 second-feet or more from Icicle Creek, except after about July 20, when the unappropriated natural flow diminishes rapidly. Then the flow of Icicle Creek will be augmented, and the water temperature will be reduced by drawing cold water from the depths of Snow Lake through a 2,500-foot tunnel, which taps it about 150 feet below its normal surface.

Ordinarily, the holding pools will be supplied with 100 second-feet of water from Icicle Creek, any excess being diverted by canal, around the holding ponds. When the unappropriated flow of the creek is inadequate and temperatures are not too high in the Wenatchee River, supplemental water from that stream will be furnished to the holding pools. If the temperature in the Wenatchee River is too high, cold water will be drawn from Snow Lake into Icicle Creek, water from the three sources being mixed to maintain a temperature not above 65°, and to conserve the Snow Lake storage.

Normally, the water from Icicle Creek and the Wenatchee River will be of satisfactory temperature for late summer and fall operations in the hatchery; but, if too warm, some well water at 50° will be supplied to the hatchery. During the winter, the addition of well water to 33° Icicle water will make a 40° degree temperature in the hatchery troughs feasible. Eggs hatch in the early winter, and fry are held in the hatchery troughs until weather conditions permit placing them in outdoor rearing ponds.

As rapidly as possible, the temperatures of rearing ponds will be raised in spring to and above 52°, probably by supplying water from the Wenatchee River, which is not so cold as Icicle Creek. Well water may be used in summer to keep rearing pond temperatures down, and in winter to keep them up to safe limits.

The hatchery and appurtenant facilities were designed and built by the Bureau of Reclamation on the basis of studies made in cooperation with the former Bureau of Fisheries and the Washington State Department of Fisheries. The plant is operated by the Federal Fish and Wildlife Service.

[Editor's Note: The salmon and steelhead trout handled at the Icicle Creek hatchery during the 1940 season represented approximately 63 percent of the total number trapped at Rock Island Dam. The remaining 37 percent were liberated in selected streams and lakes to spawn naturally. Figures for the season's operations according to species and place of liberation are as follows: The holding ponds at the hatchery on Icicle Creek received 5,299 chinook salmon, 17,133 blueback salmon, 4,190 steelhead trout, and 2 silver salmon. Plantings in Nason Creek, Wenatchee River, Entiat River, and Lake Osoyoos totalled 4,193 chinook salmon, 9,760 blueback salmon, and 1,344 steelhead trout.

An illustrated account of the methods used in trapping, hauling and liberating the fish was given in the PROGRESSIVE FISH-CULTURIST No. 47, Nov.-Dec. 1939, pp. 25-30.]

AN EDITORIAL

TAKING STOCK

THE END OF the year is an appropriate time for inventory, for a backward glance at the achievements and failures of the past, and for resolutions honestly conceived and boldly adopted for the next year. The PROGRESSIVE FISH-CULTURIST recommends such a stock-taking by the aquiculturists of the country. What mistakes have been made during 1940? What lessons from them can be learned? And what plans, based on increased understanding and renewed hope,can be made to serve the nation more effectively in 1941?

The Editor is in a mood to do likewise for the PROGRESSIVE FISH-CULTURIST. To his surprise he finds that not since issue No. 43 of January-February 1939 (how time flies !) has he spoken from the depths of his (un)easy chair. Perhaps this is as it should be. Our journal is not the product of any master-mind or brain-trust in a remote Washington office: It is the mouthpiece of the fish-culturists of the country; it is the expression of the knowledge and skill of those who devote their lives to fishery conservation.

Since the first 1939 issue ten numbers have appeared; 130 different authors have presented their ideas in 500 pages, and these have been distributed to over 3,000 readers. Among the subjects dealt with most frequently,19 articles have been concerned with general fish cultural methods, 17 have discussed the technical and practical aspects of fish nutrition and hatchery feeding, 16 have considered the broader problems of fishery management and the stocking of interior waters; 14 have dealt with the subject of hatchery diseases and hatchery sanitation, and 12 have presented brief notes or longer discussions of improved equipment for the hatchery. A number of articles, submitted voluntarily by contributors, have been critical of long established concepts in the field of fishery management and hatchery practice, and there has been a liberal sprinkling of articles on fishery biology, and on fish cultural practices in other countries. Finally, in carrying out its aim of acquainting its readers with outstanding contributions in the field of the fish cultural science and art, the PROGRESSIVE FISH-CULTURIST has reviewed critically 14 different publications of this sort and has carried abstracts of 43 such papers presented at technical meetings of local or national scope.

We believe that the PROGRESSIVE FISH-CULTURIST is influencing the thinking of practical fish-culturists. In all probability it exerts an influence in directing scientific investigation along lines that promise material practical aid and improvement. Take, for example, the prevention and cure of the diseases of hatchery fish. There are few investigators in this field. American literature on the subject is all too meager, yet within the span of two years more than a dozen articles of considerable significance on this subject have appeared in our pages.

In his article "Disease Prevention in the Trout Hatchery," Fish (43:1) emphasized the economic loss occasioned annually by uncontrolled diseases in hatcheries and he described some preliminary experiments with prolonged treatment which at that time seemed promising. Among them was the apparent success of copper sulphate for treating Western gill disease. In 45:47, Carl in his article "Furunculosis and Another Case of Ichthyophthiriasis" reported an epidemic of the latter disease in trout and salmon in British Columbia. He concluded that the disease came from infected water supplies. In 47:20, he proposed a means of preventing such losses by a closed,filtered water system, which he built and placed in operation with apparent success. In 48:1, Fish again reported on treatments for some of the most troublesome hatchery diseases in his article "Formalin for External Protozoan Parasites." He reported that treatments of formalin prevent Costiasis in trout, and that,applied for one hour, it completely eradicates the parasites.

Further development of formalin treatments was reported by Fish (49:31) as equally effective for Gyrodactylus and Trichodina. Hewitt in a note on page 39, No. 49, reported success with formalin for controlling Costiasis on fingerling trout.

Interest in these protozoan parasites resulted in two papers under the title "Control of Octomitus," (51:24). Smith and Quistorff tested the usual method of controlling Octomitus by adding calomel to the diet, concluding that it is relatively harmless for disease-free fry and fingerlings of chinook and silver salmon, and serves as a prophylactic measure. Fish and McKernan tried the calomel treatment on black spotted trout fry and compared its effects with carbarsone, finding that the latter in the diet removed all Octomitus more quickly than calomel and without harm to the fish.

Wolf in the meantime had been studying other diseases of hatchery fish in the East. In 51:37, he presented his "Further Observations on Ulcer Disease of Trout," disclosing the fact that the disease is transmitted primarily through contact with diseased fish rather than through food; that it occurs on wild fish and on hatchery fish as long as one year after planting in streams; and that continued exposure to the disease apparently produces fish that have increased resistance.

Other investigators have added to our knowledge of hitherto unrecognized fish diseases and their prevention and cure. Palmer, in 45:41, reported Diplostomiasis, a new disease of trout and other fishes. Although no treatment was described, a clue to control measures was found in the fact that it is transmitted by infested snails,fish,and birds in fish ponds. Davis reported a new fungus disease of trout, a species of Saprolegnia, which apparently can be very destructive (51:37). McKernan in his article "Treatment for Tapeworm in Trout," (50:33) recommended a new drug, kamala. Added to the food, kamala caused the expulsion of all tapeworms without harm to the fish. He suggested that this treatment might be equally effective for tapeworms at bass hatcheries, although it had not yet been tried.

Closely related to the problems of disease treatment and active measures of prophylaxis is the question of disinfection of hatcheries. Connell in his note "Sterilizing Ponds," (44:35) suggested effective means of applying liquid chlorine to ponds and water systems of hatcheries following epidemics of such diseases as furunculosis. Hagen presented an interesting article, "Sterilizing Hatchery Water Supplies," (48:19) in which he recommended the use of derris root to remove all fish from hatchery springs and intakes where chlorine failed to do the job. Wolf confirmed the value of chlorine in his article "Value of Disinfection in Ulcer Disease," (49:35) citing the prevention of a recurrence of the disease and describing a simple means of applying the disinfectant in small hatchery systems.

The practical hatchery man faces disease problems daily. In your backward glance over past months we recommend that you re-read these articles thoughtfully and critically in the hope that they will guide you over some of the rough spots you will meet during the coming year.

As to the future, the PROGRESSIVE FISH-CULTURIST is confident of continued support from an ever increasing number of contributors. During the six years of the journal's existence it has attained a sort of momentum based on the interest and good will of its readers, but it is not a perpetual motion machine. Its continued usefulness depends upon voluntary contributions of ideas, proved facts, and criticisms from men actively engaged in fish culture and fish management.

May the new year be so successful that the pages of the PROGRESSIVE FISH-CULTURIST will be filled with your records of achievement!

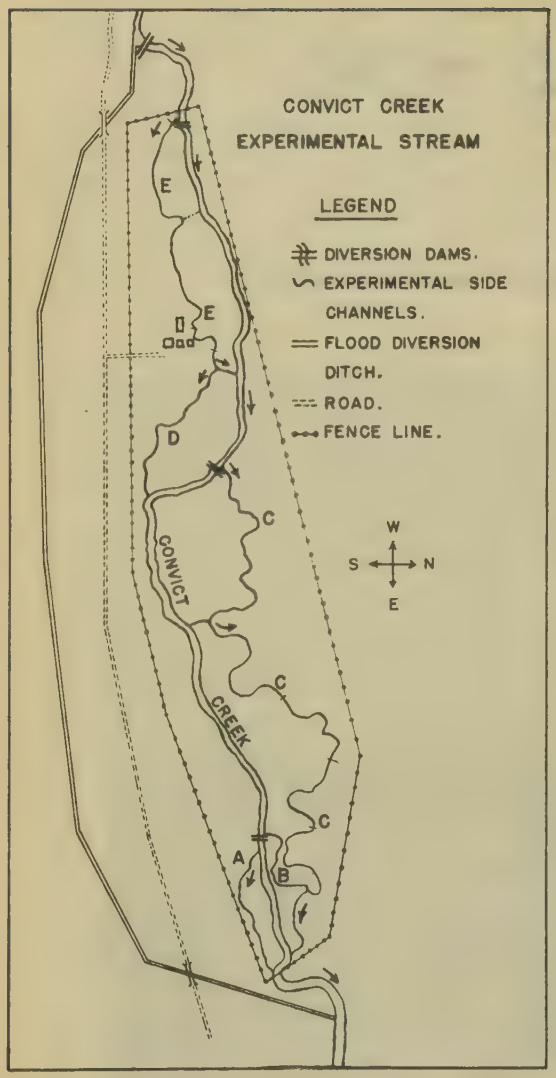
The Editor.

NOTES AND NEWS

Hatchery Added to Convict Creek Station

The Convict Creek Experimental Station in the Sierra Nevada Mountains. Left to right, the buildings are as follows: Garage-hatchery, guest cabin, laboratory - cabin, and main living cabin. Convict Creek and the experimental stream channels traverse the thicket of willows back of the buildings. The White Mountains of Nevada appear in the distance at the right.

PHYSICAL equipment for the study of trout management problems in the Convict Creek Experimental Stream, operated by the Fish and Wildlife Service near Bishop, California, was improved in September by the construction of a combination hatchery and garage building. The hatchery will provide a place to mark, hold, and grade fish, greatly simplifying these tasks during severe weather in spring and fall. Heretofore, fish have been held and marked in live cars placed in the creek. The new building will provide facilities also for eyeing and hatching trout eggs and for rearing them to suitable sizes for some of the planting experiments.



The Convict Creek Experimental Station has been operated since 1936 under the direction of Dr.Paul R. Needham. The project is designed to measure the survival rates of trout planted under various conditions and to discover the relative importance of predation, disease, water temperature,food supply,and cannibalism as causes of loss of planted stock.

Convict Creek, a typical, meadow-type trout stream,flows eastward through the Sierra Nevada Mountains in Mono County, California,at an elevation of 7,200 feet. Snow-fed lakes near the crest of the Sierras are the source of the stream, which plunges precipitously down a canyon to Convict Lake, nearly 2,000 feet below the headwaters. From the lake the stream drops another 800 feet in 2 miles to the experimental area.

Melting snow in the mountains produces a heavy flow in Convict Creek, amounting to as much as 227 cubic feet per second in some years.For this reason the creek proper is not used for experimental purposes, but water has been diverted by dams into old overflow channels, as indicated on the accompanying map. Five such side channels (designated sections A,B, C, D, and E) have been developed. The lengths of the experimental sections are as follows: A, 300 feet; B, 300 feet; C, 2,300 feet; D, 500 feet; and E, 800 feet. Each of the sections is sub-divided into 100-foot to 400-foot sections by concrete flumes, which have openings or sluiceways keyed for screens and flashboards. Each section of the stream constitutes a controlled area where the experimenter may modify such factors as sizes, numbers and species of fish planted, fish predators, and shelter. The stream bottoms are of various types -- gravel, silt, sand, rubble, and organic detritus,and most of the cover is formed by over-hanging willows, grass, branches, logs, roots, and undercut banks. A diversion ditch has now been excavated around the experimental area to by-pass excess water during spring floods. Wandering stock is excluded from the 55-acre area by a 5 strand barbed wire fence, and signs placed at 100-foot intervals indicate that the area is closed to fishing.

At the present time 4 types of investigations are being carried on in the experimental waters: (1) trout planting experiments, (2) population studies of naturally propagated trout in waters adjacent to the area, (3) studies of natural spawning of trout, and (4) trout migration studies.

Fish Counts at Bonneville Dam

ACCORDING TO reports received by the Fish and Wildlife Service from the War Department, a considerably larger number of salmon and steelhead trout ascended the Bonneville fishways during 1940 than during either of the previous seasons of operation. The total count of steelhead trout and salmon of all species had reached the figure of 734,935 by the end of November, as compared with totals of 497,070 for 1939 and 471,144 for 1938.

A feature of special interest during the latter part of the 1940 season was the operation of the fish locks, which hitherto had been used only for an occasional brief testing period. The locks were included in the fish protective structures primarily to provide a safety factor in the event that the runs should ever become too heavy to be accomodated in the ladders. On October 24,1940, the powerhouse branch of the fish ladder was temporarily taken out of operation when 545 feet of the ladder had to be removed in connection with construction work on the dam. After this time fish migrating up the south channel were diverted into the locks. Counts made at a station installed in the forebay beyond the fish lock exits indicate that the locks have functioned very successfully. During the period from October 24 to November 30, 921 salmon and steelhead trout and 249 scrap fish were transferred to the upper water level in the locks. During the same period counts in the Bradford Island fish ladder were 529 salmon and 616 scrap fish,and in the Washington shore fish ladder (where the runs are heavier normally) 1,481 salmon and 667 scrap fish.

Tabulation of fish ascending the Bonneville fishways, by months,during the 1940 season[1], with total counts for the 1938[2] and 1939 seasons for comparison.

Month	Salmon				Steelhead trout	Total salmon and steelhead trout	Total miscellaneous species[3]
	Chinook	Blueback	Silver	Chum			
February	--	--	--	--	96	96	--
March	504	--	--	--	1,688	2,192	4,645
April	37,253	--	--	--	4,125	37,253	12,005
May	28,621	206	--	--	998	29,825	41,545
June	7,028	59,639	--	--	4,489	71,156	75,419
July	14,938	85,885	--	--	61,175	161,998	40,374
August	58,643	3,063	1,451	--	46,071	109,228	16,722
September	240,515	11	10,212	--	64,377	315,115	9,298
October	3,765	1	213	860	1,786	6,625	4,264
November	287	--	33	935	292	1,447	645
Totals							
1940	391,554	148,805	11,909	1,795	185,097	734,935	204,917
1939	286,216	73,382	14,382	1,168	121,922	497,070	235,009
1938	271,799	75,040	15,185	2,117	107,003	471,144	387,270

[1]No fish were reported in January, and counts for December are not yet available. [2]Counts for 1938 cover only the period between May 7 and December 31. [3]Exclusive of lampreys.

Management Program for Oregon

PLANS FOR A 4-year survey of waters in all representative parts of the State of Oregon and for the use of the Clackamas River as an experimental and demonstration area for fishery management practices have been completed by representatives of the Fish and Wildlife Service and the Oregon Game Commission. Reed S. Neilson of the Division of Fishery Biology represented the Service at conferences with Oregon officials at which favorable action was taken on the proposed programs.

Briefly, the 4-year survey plan has been outlined to cover waters in all representative parts of the State. All surveys will be carried out in coopera-

tion with the Fish and Wildlife Service. In 1941 a survey will be made of the Rogue River and as many of its tributary lakes and streams as possible, and in 1942 the lakes and streams in northeastern Oregon, specifically in the Wallowa and Whitman National Forests, will be surveyed. Surveys during 1943 will be confined to coastal lakes and streams and some time will be given to rechecking previously surveyed waters in the State. In 1944, waters in the south-central part of the State will be surveyed. The Game Commission is to be responsible for the supervision of the surveys and the writing of reports and the Fish and Wildlife Service will act in an advisory capacity and will assist in the writing of reports and in work in the field.

The Clackamas River study, which was developed in cooperation with the Game Commission and the U. S. Forest Service, calls for intensive, long-term (not less than 5-years) studies to determine the effectiveness of best known fishery management practices and procedures. An area has been located and surveyed on the upper Clackamas River where control can be exercised and complete catch records obtained. In this area the effectiveness of planting methods, the size and species of trout planted, and the effect of restrictive measures will be checked.

The Fish and Wildlife Service will be responsible for the supervision of the Clackamas River project and also for detailed plans and reports. The Service will furnish laboratory space for the survey crews in the Clackamas Laboratory. The U. S. Forest Service will set aside the area as a demonstration area, permit the use of existing checking stations, provide housing facilities, construct improvements, and assist in the planting of fish. The Oregon Game Commission will furnish three trained biologists each year for a period of seven months, and will furnish all fish and be responsible for the marking of fish.

A Durable Fin Clipper

To distinguish the 1941 spring planting of fish in the stream in the Pisgah National Game Preserve it was decided to cut off a combination of two fins, the anal and left ventral. Clippers of the fingernail type, manufactured by Koch in Germany, had been used heretofore. The cutting edge on these is less than 1/2 inch in length, which makes them undesirable for excising fins with a wide base such as the anal and dorsal. Another fault is that they are rather soft, being made of some sort of stainless steel or other alloy, and do not maintain their cutting edge for any length of time when the fins of rather large fingerling fish are clipped. In attempting to secure a clipper with longer blades and made of good steel, it was found that metal cutting pliers known as diagonal cutters or cotter key cutters was the article desired. The chief objections to these as they come from the factory are (1) that the cutting edge is produced by grinding the jaws from both sides, thus making it impossible to cut the fins close enough to the base, and (2) that the jaws are not opened automatically by a spring after they have been closed. These faults were overcome by taking the cutters to a machine shop where the jaws were carefully ground on the smooth diagonally faced side on an emery wheel, running in an oil bath which does not alter the temper, until the part ground to produce the cutting edge from that side was removed. Then the edge was very carefully honed on a fine oil stone on the inside edge until no light could be seen coming through between the edges of the jaws. For a spring to open the jaws after they are closed a piece of a hack saw blade was ground down to a width less than that of the handles and securely riveted to one handle near the end. The other end of the hacksaw blade was bent and rounded to fit as near the fulcrum as possible and yet not interfere with the closing of the jaws.

The cutters purchased were manufactured by Kraeuter and proved to function satisfactorily. It is believed they will hold their cutting edge much longer than the nail clipper. However, being made of high grade steel, they should be dried and oiled after being used to prevent rusting. -- Reuben O. Knuth, Leetown Station.

ABSTRACTS

Through the courtesy of the Executive Committee of the American Fisheries Society, the following abstracts of papers presented at the 1940 meetings of the Society have been made available for publication in the PROGRESSIVE FISH-CULTURIST. The editors regret that limitation of space prevents the publication of abstracts of other interesting papers which will appear in the forthcoming volume of the Transactions of the American Fisheries Society.

PARASITES OF FISH OF ALGONQUIN PARK LAKES

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In the study of the parasites of fish from lakes in Algonquin Park, Ontario, 560 fish of 22 species were examined and 84.3 percent carried at least one form. Many of the fish carried larval trematodes which have fish-eating birds as their definitive hosts. Lakes containing smallmouth black bass had several species of fish infested with larval cysts of the cestode, Proteocephalus ambloplitis (Leidy). Fish from lakes that did not contain smallmouth black bass did not carry this cestode. Proteocephalus fluviatilis Bangham, described previously only as a parasite of fish was found on 24 percent of the common suckers. Ten species of fish examined were of the family Cyprinidae. Of these minnows 64.4 percent were infested with at least one species of parasite. The parasites of the minnows were of few different species and the majority of the parasites were larval. The 12 remaining species of fish had 97.5 percent infestation in those that were examined. The distribution of fish parasites from the 11 lakes where parasitized fish were secured is discussed.

ARTIFICIAL FEEDING OF WHITEFISH FRY

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Winnipeg, Canada

Through experiments conducted at the Winnipegosis and Dauphin River hatcheries in Manitoba, it has been determined that the artificial feeding of whitefish fry (Coregonus clupeaformis) is of value in those localities where the eggs hatch early in the spring and fry must otherwise be planted while the lakes are covered with ice. At that time the existence of an adequate supply of food organisms is uncertain. Various artificial foods were tried in the experiments but the most satisfactory results were obtained with (1) natural plankton (principally Daphnia pulex) and ground beef heart, and (2) natural plankton alone. During the hatching period three successive batches of fry may be held in tanks and fed for a 10-day period before they are released. Fry gain in weight, length and viability during the period of artificial feeding and are better fitted for survival in the natural environment. Through the delay in planting, the supply of available natural food and the temperature of the water in the lake environment are enabled to become more favorable by the time the fry are ready to be transferred from the tanks to the lake.

AN INVESTIGATION OF THE USE OF OXYGEN IN TRANSPORTING TROUT

David C. Haskell
New York State Conservation Department
Gansevoort,New York

An investigation was made of the use of tanks oxygenated for transporting fish by the liberation of small bubbles of oxygen gas. A series of experiments was conducted to show the relation of the quantity of oxygen liberated, size of tank, depth of water, and water temperature to (1) the quantity of oxygen which dissolves in the water, and (2) the weight of trout that may be carried. The results have specific application to the smaller type of tank used by the New York Conservation Department,which is 48 inches long, 18 inches wide, and 28½ inches deep, and is supplied with oxygen by 2 spherical liberators of a porous material. The general principles of operation are believed to be applicable to any tank using a system of oxygen liberation. The results of the experiments conducted led the author to offer the following suggestions for the safe operation of tanks supplied with oxygen by liberators:

1. A large amount of oxygen should be supplied during the first hour of a shipment. The oxygen should be turned on for a few minutes before the fish are loaded. After the first hour the oxygen flow may be reduced.
2. When possible weighing and counting of fish should be done on the day before shipment in order to reduce the excitement due to handling.
3. Icing of the tank should begin as soon as the fish are loaded. The temperature should be maintained at a low value during the entire shipment.
4. If fish manifest distress during transportation, believed to be caused by lack of oxygen, the flow from each liberator should be increased greatly since it will take some time to build up a safe oxygen content even at a rapid delivery rate.

The experimental results and conclusions of this paper apply only to 5½ inch brown trout and they should not be applied specifically to other species or sizes of fish without additional experimentation.

THE LENGTH OF THE GROWING SEASON OF LARGEMOUTH AND SMALLMOUTH BLACK BASS IN NORRIS RESERVOIR,TENNESSEE

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The length of the growing season of largemouth black bass and smallmouth black bass in Norris Reservoir for 1939 has been calculated to be not more than 4 months. The season's growth in both species of bass began after late May. The largemouth black bass had completed their growth by the early part of October, and the smallmouth black bass by the latter part of September. This 4-month growing period corresponded to that during which the water in the lake was 75° F.or above, and was much shorter than the agricultural growing season of 7 months.

RESTORATION OF THE ATLANTIC SALMON IN NEW ENGLAND

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The Atlantic salmon, Salmo salar Linnaeus, has been practically exterminated from New England waters as a result of heavy fishing, deforestation, pollution, and the construction of dams or other obstructions to migrations. In recent years, conditions on some of the streams have been improved due to the abatement of many of these harmful conditions, and it now seems probable that an adequate restoration program would prove successful. A comprehensive program is proposed which calls for the following: A detailed survey of all potential salmon streams to determine their present condition; the selection of the best stream or streams for experimental work; the formulation of State laws to provide control of all fishing operations; a program of scientific observation and analysis including annual enumeration of the spawning stock; the determination of the numbers and mortality of naturally-spawned young in different tributaries and the mortality of hatchery-produced young released at different ages and at different seasons, with the ultimate object of determining the optimum size of the spawning run for each main tributary.

FLUCTUATIONS IN LENGTHS AND NUMBERS OF CERTAIN SPECIES OF FISHES OVER A FIVE-YEAR PERIOD IN WHITMORE LAKE, MICHIGAN

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Largemouth black bass, bluegills, and yellow and brown bullheads were taken annually in Whitmore Lake in the same manner and with the same types of legal tackle during the summers of 1934-1938. The length-frequency curves obtained yearly for each species indicate an annual increase in average lengths from 1934 to 1937 and/or 1938. Fishes spawned in the years 1931-1933 dominated between 1934 and 1936, and largemouth black bass of the 1931-1933 year classes apparently formed the principal fish predators in 1934 and 1935. In 1934 and 1935 the fry survival of all species was low, despite good hatches. Evidence indicates that the adult largemouth black bass population was low during 1936 and 1937; during these years the survival of fry of all species was high, although the hatches were seemingly no better than in previous years. The largemouth black bass hatched in 1936 and 1937 were exceedingly abundant in 1938, and unless a great reduction in their numbers occurred they might be sufficiently numerous to devour most of the fry produced by all species in the next few years. It is suggested that a predator-prey relationship may exist, and that a relationship of this type may be the source of cyclic fluctuations in abundance.

CONTROL OF SPATTERDOCK (NUPHAR ADVENA AIT.) IN PONDS

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Spatterdock (Nuphar advena Ait.) is an objectionable weed in Southern ponds where its emergent leaves forma dense vegetation in which it is difficult or impossible to fish. Experiments dealing with the control of this plant were conducted in a pond in Central Alabama during the spring and summer, 1940. The results of these experiments are summarized briefly: (1) Spatterdock was effectively controlled by cutting the leaves five times (May 15, June 4, June 21, July 2, and July 24). (2) Four cuttings (June 4, June 21, July 2, and July 24) effectively controlled the plant when commercial fertilizer was applied on the first cutting date. (3) Effective control was obtained by pulling the rootstocks on May 15, and allowing the plants to remain in the pond. (4) Death and decay of the rootstocks of spatterdock began toward the base and progressed to the apex. (5) Sprays consisting of mixtures of creosote and fuel oil, and sodium chlorate and sodium arsenite killed the leaves of spatterdock but did not injure the rootstocks.

THE AVAILABILITY OF SMALLMOUTH BLACK BASS, MICROPTERUS DOLOMIEU LACEPEDE, IN LAKES OF ALGONQUIN PARK, ONTARIO

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The relationship between the availability, as measured by the number of fish caught per 100 boat hours fishing, and the average size of the lake trout caught as shown by Fry in recent studies of lakes of Algonquin Park, Ontario, has its counterpart in smallmouth black bass populations in lakes of the same park and may be used to classify different fisheries. The peak availability of approximately 300 bass per 100 boat hours falls between 11 and 12 inches, whereas the availability between 13 and 14 inches is around 150 captures per 100 boat hours. The availability of both the legal smallmouth black bass and those caught below 10 inches is highest where the average length of the bass caught is small. The total annual removal in pounds per acre in certain Algonquin Park lakes has been tabulated. This tabulation demonstrates a rough relationship between the area of the lake and the average length of the bass present in it. The lakes in which the average length of the fish caught is small have the highest annual removal in pounds per acre.

REVIEWS

NATURAL REPRODUCTION OF TROUT IN NEW ZEALAND AND ITS RELATION TO DENSITY OF POPULATIONS

By Derisley F. Hobbs
New Zealand Marine Department, Fisheries Bulletin, No. 8, 93 pp.
Wellington 1940

IN THE PROGRESSIVE FISH-CULTURIST of January 1938 I reviewed Mr. Hobbs' earlier publication, "Natural Reproduction of Quinnat Salmon, Brown and Rainbow Trout in certain New Zealand Waters." At that time I stressed the significance of Hobbs' work as one of the few attempts at a thorough-going and scientific evaluation of the actual efficiency of natural reproduction in fishes. For the first time adequate evidence was brought forward in refutation of the often repeated but never proven contention that the natural reproduction of salmonids is woefully inefficient - that in nature only a small percentage of eggs is fertilized - that natural mortality is excessively high among these few fertile eggs. Mr. Hobbs demonstrated that more than 99 percent of naturally spawned eggs were fertilized and that the subsequent mortality in the redds was extremely low.

In the words of the author the purpose of the present study (which was based entirely on brown trout and rainbow trout) was "to establish how general an application conclusions drawn from earlier observations had." The original investigation was confined to streams in the Canterbury and Westland regions near the middle of the South Island. The paper to be reviewed here was based on extensive observations in the Auckland region in the northern half of the North Island and the Otago and Southland districts in the southern part of the South Island.

The newer observations were in general agreement with the older ones. The widespread applicability of the conclusions therefore is demonstrated. The agreement of the results obtained in the various localities is especially significant since the present investigation was carried out "in widely separated parts of New Zealand, offering the principal contrasts of conditions that the better-known angling waters of this country show . . ." In New Zealand as a whole the natural reproduction of trout is a highly efficient process. Losses of eggs through nonfertilization are negligible, and under normal conditions more than 90 percent of the eggs deposited in a redd may be expected to hatch.

Hobbs' more recent paper contains rather detailed considerations of the sources of losses of eggs. Among the losses that could not be measured are those involving the removal of eggs and fry from the redds by floods or by the activities of the trout themselves when new redds are superimposed directly on beds that already contain eggs.

Flood losses involving the actual removal of eggs and fry from the redds are far smaller than might be expected; indeed, "in many streams the chances of flood losses are very remote, while in others, while losses occur, they do so only at irregular intervals." Among the most important of several explanations of the small losses from floods is the selection by the trout of the more stable portions of the stream bed for the construction of redds.

In badly congested spawning areas spawning trout may at times destroy completely preexisting redds, throwing the eggs into the stream. Losses from this source also could not be measured.

Other losses resulting from floods and the superimposition of redds could be measured, and did in fact contribute substantially to the total mortality determined by Hobbs. The redds from which he took specimens included redds that had been damaged by the deposition of silt and other fine materials or in which eggs or fry had been disturbed and injured but not carried away. The examination of the frequency distribution of the percentage loss in various localities revealed that a large proportion of the total number of dead eggs and fry in his collections was contributed by a relatively small number of samples.

After a careful consideration of conditions controlling density of trout populations in New Zealand, Hobbs concluded that the scarcity of suitable spawning areas rather than a lack of food or the inroads of predators served as the most important limiting factor. So congested are the spawning areas for trout in New Zealand streams that the superimposition of redds is of general occurrence. The extent and the effects of the superimposition may vary. If the superimposition consists only of a slight overlapping of adjacent redds the effects on the success of reproduction may be small or negligible. As the congestion becomes greater the harmful effects of superimposition increase. The point finally may be reached where each new spawner in preparing its redd destroys as many eggs as it contributes, and hence adds nothing to the total of young produced.

Spawners that contribute little or nothing to natural reproduction obviously constitute an exploitable excess. Furthermore, there would appear to be an "optimum level of abundance" which if it could be maintained would provide a maximum annual exploitable excess without change in the number of young produced. It does not seem desirable to review in detail at present Hobbs' comments on these points or his remarks concerning the introduction of artificially propagated fish for the maintenance of the stock. It would appear to be better to await the appearance of his proposed publication on the "question of man's endeavors to aid the maintenance of stock. . ."

Hobbs' observations concerning the requirements of trout with respect to spawning localities should be of great value to those who are interested in estimating the spawning facilities provided by streams. Apparently the spawning requirements are "very special . . . as regards (1) size of stones, (2) degree of consolidation, and (3) gradient." Rather than utilize areas that do not conform to their requirements trout will construct redds in localities that have already been used by earlier spawners. It is to be noted especially that they "do not spawn in loose clean gravel, but in gravel admixed with finer materials and to some extent consolidated." Trout avoid localities with more than a slight gradient in the direction of flow and require also that the bed be nearly level at right angles to the current.

The extremely special requirements of trout account for the scarcity of suitable spawning grounds. In a 20-mile stretch of the Kakanui River, a stream that in comparison with other New Zealand rivers was well provided with spawning localities, the spawning beds actually present covered only 0.15 percent of the bottom. Other areas were unsuitable with respect to the size of gravel, the stability of the bed or the gradient. These observations suggest that a reliable estimate of potential spawning grounds in a stream may require not only observations of the surface gravel but also a careful examination of the substratum and of the gradient.

Ralph Hile

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WATER CONDITIONS AFFECTING AQUATIC LIFE

IN ELEPHANT BUTTE RESERVOIR

In Fishery Bulletin No. 34, published by the Fish and Wildlife Service during December, Dr. M. M. Ellis presents the results of a 4-year study of the physical and chemical conditions in the waters of Elephant Butte Reservoir, N. Mex. Dr. Ellis' data will be of interest to a large number of fishery investigators, administrators, and fish-culturists because they are applicable to many impoundments in addition to Elephant Butte. The detailed analyses of water characteristics, including temperature, dissolved oxygen, hydrogenion concentration, specific conductivity, and turbidity give a significant picture of conditions that will be found in many large impoundments which, like Elephant Butte, have passed the early period of major physical and chemical adjustments.

Biological aspects are discussed in a brief section which reviews the fish fauna and shows how the physical and chemical conditions operate to restrict both the extent and variety of the fish populations and how they impose certain limitations on productivity which should be considered in planning stocking programs.

Fishery Bulletin No. 34, WATER CONDITIONS AFFECTING AQUATIC LIFE IN ELEPHANT BUTTE RESERVOIR, by M. M. Ellis, may be obtained from the Superintendent of Documents, Washington, D. C. The price is 20 cents.